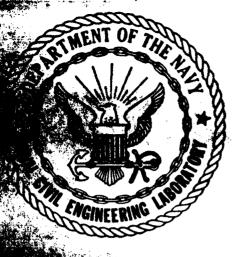




MICROCOPY RESOLUTION TEST CHART MATIONAL BUREAU-OF STANDARDS-1963-A





CR 84.001

COAL-USE ECONOMICS METHODOLOGY FOR NAVY BASES

OF ENGINEERING SERVICES FOR COAL CONVERSION GUIDANCE

Fatruary 1984

P.O. Box 3965
San Francisco, CA 94119

N00123-82-D-0321

, <u>a</u> 0 (80

Approved for public release; distribution is unlimited.

		*	*	ì	K			inch	ğ	1) ş			e e		unces			***	eet	ards,		4		teniperature			l
Tio Messe	اع		inches	Fred Park	yards	Tiles		aumits.	arends.	Scres		SOUNO	ponud	short tons		fluid ounce	pints	quarts	gallons	cubic feet	cubic yards	-		ramenuent	tent			
preions from Metric A	Multiply by	LENGTH	5 .0	÷ .	3 <u>T</u>	9.0	AREA	0.16	1.2	0.4 2.5	MASS (weight)	0.035	2.2	<u>:</u>	VOLUME	0.03	2.1	1.06	0.26	93	τ .	TEMPERATURE (exact)	O.E. taken	uau1) c./6	add 32)			
	Phon You King		S. S			oters		square contimeturs.	quare meters	square kilometers				tonnes (1,000 kg)		iars 2				cubic meters	cubic meters	TEMPE			temperature			
₹	ğ.		millimeters	Centimeter	meters	kilometers		somere	Square	square hectar		OF BITTE	kilograms	tonne		milliliters		liters	liters	capic	cubic			Seisius	te a			
je.	3		E	€ 1	E	Ŕ		can can a	'n.	ž Ž	<u></u>	a	.	-		Ē	_	-		E.	E		6	ر				
z :	Si	50 	6I	°		(1 : 	181		1	1	13		13	11		OI	1	1	8	1	4	1	9		9]	L	E
istal.	ils fal:	Tire Tire		112	P P	o fof :	ilii.		ret Tele		al al a	i ji	יןי	14 1	ין ין	in:	19 1	11	٠,٠	}*}	1111	*}	, ;	**	# Pr	n jo	ייןין	ıp y
1	8	.	' '		,		Ι'	6	1.	1.	15	' I '		' '		' i '	'	٠,	•	,	1.]	' !		2	'	''	
خ مشا وه دو خواه	Symbol		5	£	εž		7	E.V.	•	7	_						7	7										
				~	€ 5		,	5 5	~E	£ 2	•	a	Š	•			•	E	Ē	-	-	-	_`	Ę	E		ပ	
berts Messure	To Find		centimeters	ters 4	meters ri			square centimeters or source.		iers		or ame	kilograms	tonnes			milliliters	milliliters	milliliters	liters	liters	liters	liters 1 3	cubic meters m	cubic meters m ³	12	hsius	temperature
Conversions to Metric Measures	Muhiph by To Find	LENGTH	*2.5 centimeters	*					aquere meters		reight)		0.45 kilograms kg			VOLUME	5 milliliters A	15 milliliters n	30 milliliters må	0.24 liters 1	_					WERATURE (exact)	hsius	subtracting temperature
Approximate Conversions to Metric Meaures		LENGTH	*2.5	30 centimeters		ABEA		0.0 square centimeters	0.8 square meters	squere kilometers	MASS (weight)		0.45	0.9		VOLUME	teaspoons 5 milliliters A	2	fluid ounces 30 milliliters mi	0.24	_	0.95	3.8	0.03	cubic meters	TEMPERATURE (exact)	hsius	re subtracting

F }

*1 in = 2.54 (anacthy), For other exact conventions and more desiried tables, set NBB Misc. Pals 1265, Links of Weights and Mesures, Price \$2.25, SD Creatog No. C15.19:285.

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Date Entered) READ INSTRUCTIONS BEFORE COMPLETING FORM REPORT DOCUMENTATION PAGE GEFORE COMPLETING FO CR 84.001 TYPE OF REPORT & PERIOD COVERED A Coal-Use Economics Methodology for Navy Bases Phase I of Engineering Services for Coal Conversion Final 10ct 1982-30Sep 1983 Gui dance CONTRACT OR GRANT NUMBER(4) A.I. McCone, G.F. Moyer N62474-82-C-8290 Bechtel Group, Inc. P.O. Box 3965 San Francisco, CA 94119 TO PROGRAM ELEMENT. PROJECT. TASK Z0829-01-411A 2 REPORT DATE Naval Civil Engineering Laboratory February 1984

13 NUMBER OF PAGES
192 Port Hueneme, ČA 93043 MONITORING AGENCY NAME & ADDRESS(I dillerent from Controlling Office) SECURITY CLASS (of this report) Naval Facilities Engineering Command **Unclassified** 200 Stovall Street 150 DECLASSIFICATION DOWNGRADING Alexandria, VA 22332 SISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution is unlimited. " DISTRIBUTION STATEMENT for the obstract entered in Bluck 20, if different from Report) . S.PPLEMENTARY NOTES will a DROS Continue on reverse side if necessary and identify by block number coal, economics, methodology, conversion ABSTRACT (Continue on reverse side if necessary and identify by block number) > A methodology for calculating coal facility life cycle costs using commercial economic methods as well as Navy economic methods was prepared. The methodology permits calculation of life cycle present values, unit present values, levelized costs, and unit levelized costs for Navy financed/Navy operated ventures, third party financed/Navy

DD . - CHM 1473 EDITION OF 1 NOV 45 IS DESOLETE

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (Men Date Entered)

SECURITY CLASSIFICATION OF THIS PAGE(When Date Entered

operated ventures, and third party financed/third party operated (all private) ventures. The methodology also permits calculation of savings/investment ratios and payback periods for the three venture types.

The attached user manual was prepared for a computer program that calculates coal-use project life cycle costs under both Navy and commercial economic assumptions. The manual describes computational methods, program input, program output, program execution, error processing, test procedures, and code structure. Appendices include output generated for four sample cases and a procedure to converge to a desired calculated quantity by a method of successive trials.

Unclassified

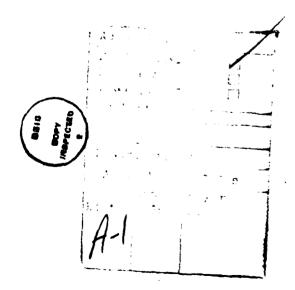
NOTICE

This report was prepared by Bechtel Group, Inc. (BGI) as an element of work performed under, and in accordance with, the provisions of the U.S. Naval Civil Engineering Laboratory (NCEL) Contract N62474-82-C-8290. Neither BGI nor any person acting on its behalf makes any warranty, express or implied, with respect to the use of any information, apparatus, method, or process disclosed in this report, or that such use may not infringe privately owned rights; or assumes any liabilities with respect to the use of, or for damages resulting from the use of, any information, apparatus, method, or process disclosed in this report.

ACKNOWLEDGMENTS

The authors thank the contract monitor, D. E. Williams, of the Naval Civil Engineering Laboratory, for his review and comments.

Computer program COALR has been adapted by Bechtel from COALC - Coal Conversion Cost Program, written by C. R. Biddle and R. I. Malakoff of Peter L. Loftus Corporation, Pittsburgh, Pennsylvania. C. R. Biddle provided helpful advice on features of the program.



Part & Partie Laboration Control Contr

CONTENTS

Section				Page
1	INTRO	DUCTION		1-1
	1.1	Objecti	ves	1-2
	1.2	Technic	al Approach	1-2
	1.3	Report (Organization	1-4
2	SUMMA	RY		2-1
	2.1	The Coa	l-Use Economics Methodology	2-1
		2.1.1	Navy and Commercial Economics	2-1
		2.1.2	Financial Statistics	2-2
		2.1.3	Venture Structures	2-3
	:	2.1.4	Startup Year Versus Display Year Dollars	2-3
	;	2.1.5	Comparisons with Use of Oil or Gas	2-3
	2.2	The Phas	se I Computer Program	2-3
3	THE C	DAL-USE	ECONOMICS METHODOLOGY	3-1
	3.1	Input De	ata Reformulation	3-2
	:	3.1.1	Reference Times	3-2
	:	3.1.2	Adjustment of Cost Estimate Reference Times	3-3
	3.2	Treatmen	nt of Discounting and Inflation	3-3
	:	3.2.1	Present Values	3-4
	:	3.2.2	Levelized Costs	3-5
	:	3.2.3	Effects of General Inflation	3-5
	•	3.2.4	Differential Inflation of Purchased Energy	3-7

Section				Page
	3.3	Project	: Life Cycle Costs	3-8
	3.4	Private	e Sector Income Taxes	3-11
	3.5	Analyse	es of Costs and Benefits	3-12
		3.5.1	Navy Comparison Statistics	3-12
		3.5.2	Commercial Comparison Statistics	3-14
	3.6	Venture	es Analyzed and Reports Generated	3-16
4	AUTO	MATION C	OF THE COAL-USE ECONOMICS METHODOLOGY	4-1
	4.1	Navy Fi	nanced/Navy Operated Ventures	4-2
		4.1.1	Report 1 - Navy Present Values in Display Year Dollars	4-2
		4.1.2	Report 2 - Navy Levelized Costs in Display Year Dollars	4-4
		4.1.3	Report 3 - Navy Cost and Benefit Analysis	4-6
		4.1.4	Reports 4 and 5 - Startup Year Dollar Tables	4-8
	4.2	Third P	arty Financed/Navy Operated Ventures	4-8
		4.2.1	Report 6 - Investor Cash Flows During Construction Period	4-8
		4.2.2	Report 7 - Investor Cash Flows During Operating Period	4-12
	•	4.2.3	Report 8 - Navy Cash Flows During Operation Period	4-12
	4.3		arty Financed/Third Party Operated ivate) Ventures	4-15
		4.3.1	Report 9 - Private Venture Cash Flows During Construction Period	4-15
		4.3.2	Report 10 - Private Venture Cash Flows During Operating Period	4-17
		4.3.3	Reports 11 and 12 - Minimum Revenue	

THE PARTY CONTROL OF THE PROPERTY OF THE PARTY OF THE PAR

Section				Page
	4.4	Summer	ies and Comparisons -	4-19
		4.4.1	Report 13 - Comparison of Navy Financed/Navy Operated and Third Party Financed/Navy Operated Ventures	4-19
		4.4.2	Report 14 - Comparison of Navy Financed/Navy Operated and Third Party Financed/Third Party Operated (All Private) Ventures	4-23
5	NONP	ROFIT EN	NTITY PROJECTS	5-1
	REFE	RENCES		R
COMPI	uter 1	PROGRAM	USER MANUAL	
	COAL	R-Coal C	Conversion Cost Reformulation Program	A

TABLES

Table		Page
2-1	Comparison of Financial Statistics Using Navy and Commercial Economics for a Typical Coal-Use Project	2-6
3-1	Typical Current Dollar and Constant Dollar Discount Rates for 6 Percent Per Year General Inflation	3-6
3-2	Typical Differential Inflation Rates for Energy Purchased by Navy Bases	3-8
3-3	Methods for Calculating Capital Depreciation for Tax Purposes	3-13
4-1	Report 1 - Navy Present Values in Display Year Dollars	4-3
4-2	Report 2 - Navy Levelized Costs in Display Year Dollars	4-5
4-3	Report 3 - Navy Cost and Benefit Analysis	4-7
4-4	Report 4 - Navy Present Values in Startup Year Dollars	4-9
4-5	Report 5 - Navy Levelized Costs in Startup Year Dollars	4-10
4-6	Report 6 - Third Party Financed/Navy Operated Venture: Investor Cash Flows During Construction Period	4-11
4-7	Report 7 - Third Party Financed/Navy Operated Venture: Investor Cash Flows During Operating Period	4-13
4-8	Report 8 - Third Party Financed/Navy Operated Venture: Navy Cash Flows During Operating Period	4-14
4-9	Report 9 - Private Venture Cash Flows During Construction Period	4-16
-10	Report 10 - Private Venture Cash Flows During Operating Period	4-18
-11	Report 11 - Private Venture Minimum Revenue Requirements Discounting with Weighted Cost of Capital	4-20
-12	Report 12 - Private Venture Minimum Revenue Requirements	4-21

Table				Page
4-13	Report 13	•	Navy Financed/Navy Operated Venture Party Financed/Navy Operated Venture	4-22
4-14	Report 14	vs. Third	Navy Financed/Navy Operated Venture Party Financed/Third Party Operated ate) Venture	4-24

SSST COLORSO, VARIOUS RECORDE VICULOR SALVORO COLORSO COLORSO COLORSO (PORTORIO (PORTORIO) (PORTORIO) (PORTORIO)

ILLUS.TRATIONS

Figur	<u>e</u>	Page
2-1	Coal Use Economics Methodology Reports	2-5
3-1	Operation of the Coal-Use Economics Methodology	3-2
3-2	Typical Cost Cash Flow Diagram of Coal Conversion Projects	3-9

Section 1

INTRODUCTION

The Naval Civil Engineering Laboratory (NCEL) at Port Hueneme, California, is developing data and computational tools for calculating the cost of converting shore station heating and power generation facilities from high-priced oil and natural gas to lower-priced coal.

This report describes the work performed by Bechtel Group, Inc. to support these NCEL efforts, in Phase I of Navy Contract N62474-82-C-8290 with NCEL, entitled, "Engineering Services for Coal Conversion Guidance." This contract is a 15-month effort with three concurrent phases.

The Phase I work included definition of a methodology for calculating coal facility life cycle costs using commercial economic methods, as well as the economic methods customarily used by the Navy. It also included preparation of a computer program to permit converting from one of the forms of economic analysis into the other. Results of these analyses may be used by the Navy as economics input to decisions on shore station heating plant projects.

THE PARTY INDICATE AND THE CONTRACT OF THE PARTY AND THE P

The Phase II work included development of a data base on the cost and performance of burning coal-water mixtures and coal-oil mixtures in coal-capable retrofitted boilers, and incorporation of this information in a computer program. This program calculates component and total costs of steam and power generation facilities for a Navy base of arbitrary configuration, under a variety of user-chosen assumptions. The program calculates life cycle costs under commercial as well as Navy economic assumptions. The program includes data prepared for NCEL on previous studies and the new data generated in the Phase II work.

The Phase III work included updating a previous study for NCEL, which compared a variety of coal conversion technologies under several degrees of steam plant decentralization, and preparation of a computer program to present the technology comparisons under a variety of user-chosen assumptions. The program includes the capability of calculating life cycle costs using Navy or commercial economics. The Phase III data includes costs for converting coal to gaseous and liquid fuels developed in prior studies for NCEL.

The computer programs for the three phases were adapted from a computer program prepared previously for NCEL. There is a separate report for each phase of the contract, and a separate user's manual for the computer program developed in each phase.

1.1 OBJECTIVES

The objectives of the Phase I effort were to:

- Formulate a coal-use economics methodology that calculates financial statistics using both Nevy and commercial financial assumptions
- Prepare the Phase I computer program to automate the coal-use economics methodology

1.2 TECHNICAL APPROACH

Formulation of the coal-use economics methodology included the following steps:

- Establishment of methodology requirements
- Selection of analysis methods
- Structuring of the calculation procedures
- Preparation of calculation algorithms

The methodology is to have the following capabilities:

 Calculation of life cycle costs in both startup year dollars and dollars of some other "display" year

- Calculation of cost savings when oil or gas, burned in existing boilers, is replaced with coal
- Calculation of costs using both Navy and commercial financial assumptions in the same runs so results can be compared
- Accommodation of the following economic scenarios:
 - Navy financed and operated
 - third-party financed and Navy operated
 - privately financed and operated
 - nonprofit entity financed and operated
- Inclusion of general inflation and differential inflation for purchased energy, such as electricity, coal, natural gas, fuel oil, and steam
- Provision to use various capital structures, depreciation rates, and tax rates

After establishment of the above requirements, the following analysis methods were selected:

- Present value analyses were made the basis for all calculations.
- Inflation factors were introduced, and the relationship between current (inflating) dollars and constant (real) dollars was defined.
- Life cycle costs were converted to Navy levelized costs and commercial minimum revenue requirements.
- e Comparisons with a base case of oil or gas consumption were calculated on a year-by-year basis by discounting Navy savings and commercial after-tax cash flows.

The calculation procedures were then structured into logically discrete routines, and calculation algorithms for all routines were prepared.

Following formulation of the methodology, the Phase I computer program was prepared. The program structure was adapted from the already existing NCEL computer program in the following manner:

- Input interpretation routines were retained and user input recognition and echo routines were prepared.
- A routine was built to reformulate input project costs to allow the user to select the desired year and cost basis.
- The existing program's Navy economics routine was updated and two additional Navy economics routines were prepared.
- Routines were added to calculate investor cash flows during construction and operating periods and to calculate commercial minimum revenue requirements.
- · Summary routines were prepared.

Upon completion, program results were verified by comparison with hand calculations for the various program options.

The Phase I work used a number of Navy documents as references:

References 1-1 through 1-4 describe the Navy economics methodology incorporated in the coal-use economics methodology. Reference 1-5 gives Navy recommended differential inflation rates used in this report to generate the technology cost comparisons. Reference 1-6 describes the existing NCEL computer program which was used in the construction of the Phase I computer program.

1.3 REPORT ORGANIZATION

Section 2 summarizes the results of the Phase I efforts resulting in the coal-use economics methodology and its embodiment in the Phase I computer program. Section 3 presents the coal-use economics methodology. Section 4 describes automation of the methodology in the Phase I computer program. It describes the reports generated by the methodology for Navy, third party/Navy, and all private ventures, and the summary reports comparing Navy and commercial economic scenarios. Section 5 describes use of the methodology for projects undertaken by nonprofit and governmental entities.

Section 2

SUDGLARY

This section summarizes the results of the Phase I efforts to develop a coal-use economics methodology and its embodiment in the Phase I computer program.

2.1 THE COAL-USE ECONOMICS METHODOLOGY

The coal-use economics methodology has been constructed as a versatile tool to display side by side the results of economic analyses with different economic scenarios. The methodology has the following capabilities:

- Bconomic analyses using both Navy and commercial financial assumptions
- Determination of seven commonly recognized financial statistics
- Treatment of three venture structures
- Statistics in both startup year and display year dollars
- Economic comparisons of coal use with the use of fuel oil or natural gas

2.1.1 Navy and Commercial Economics

The methodology includes both Navy and commercial economic analyses. Similarities between the two analyses are that:

- Both are based upon computation of project present values, using discount rates chosen by the user.
- Both aim to produce capital charge rates typical of those encountered in the private sector.

The two analyses differ principally in the way they take into account corporate income taxes paid by the private sector:

- The Navy economic analysis achieves the reality of private sector capital charges by using a discount rate that is an average of corporate gross profit rates since World War II. This discount rate includes both the cost of return to investors and an allowance for the cost of private sector corporate income taxes. Since the Navy pays no income taxes, they are not explicitly calculated.
- The commercial economic analysis uses a discount rate that contains only return to investors. This discount rate produces a capital charge term that contains only return to investors. To obtain a total capital charge, a term is added for capitalizing the corporate income taxes, calculated under present or previous tax laws for depreciation and investment credits.

2.1.2 Financial Statistics

The coal-use economics methodology operates on project costs (capital and operating costs) to produce seven commonly recognized financial statistics for comparing energy project life cycle costs. These statistics are:

- o Present value
- Unit present value
- Levelized cost
- Unit levelized cost
- Savings/investment ratio
- Discounted payback period
- Simple payback period

All seven statistics are calculated for commercial economics. Only the first six are calculated for Navy economics. For both Navy and commercial economics, the levelized costs and unit levelized costs are calculated in constant (real) dollars. Unit levelized costs in constant dollars per million Btu can be validly compared with current purchased energy prices.

2.1.3 Venture Structures

The methodology treats the following three venture structures:

- Structure 1 Navy financing/Navy operation
- Structure 2 Third party financing/Navy operation
- Structure 3 Third party financing/third party operation (all private)

Statistics for Structure 1 are calculated with Navy economics only. Statistics for Structure 2 are calculated using Navy economics, except for lease payments, which are determined by commercial economics. Statistics for Structure 3 are calculated entirely with commercial economics. Structure 3 can also be used for nonprofit organizationeprojects by ignoring taxes.

2.1.4 Startup Year Versus Display Year Dollars

The financial statistics are presented in both plant startup year dollars and dollars of an arbitrary year selected by the user, called the display year. Purchased energy price input data are entered in display year dollars.

2.1.5 Comparisons with Use of Oil or Gas

The methodology includes analyses of both the costs and economic benefits of displacing fuel oil or natural gas by a new coal-use project. The comparison analyses calculate three financial statistics: the savings/investment ratio, the discounted payback period, and the simple payback period.

2.2 THE PHASE I COMPUTER PROGRAM

ROSSER , CONTROL BESTER CONTROL BOSES OF THE SECOND STATES OF THE SECOND SECOND

The Phase 1 computer program, entitled "COALR - Coal Conversion Cost Reformulation Program," includes the entire coal-use economics methodology described above. The program operates on project costs, which are input by the user, and the output is reformulated to the user's choice of display year and cost basis.

Figure 2-1 names the 14 possible reports generated by the Phase I program. The Navy financed/Navy operated venture option is reported for all runs. The other reports generated in a given run depend on the user-selected commercial venture option (third party financed or all private).

Table 2-1 compares Navy and commercial financial statistics from a typical run of the Phase I computer program. The results show that the Navy and commercial analyses produce levelized costs of comparable magnitude.

In summary, the coal-use economics methodology and the computer program COALR constitute a versatile analytical tool for comparing the economic viability of options to supply steam at Navy shore bases. The program also served as a basis for the programs in Phases II and III of this contract.

NAVY FINANCED/NAVY OPERATED VENTURE

REPORT 1

NAVY PRESENT VALUES IN DISPLAY YEAR DOLLARS **REPORT 2**

NAVY LEVELIZED COSTS IN DISPLAY YEAR DOLLARS **REPORT 3**

NAVY COST AND BENEFIT ANALYSIS

REPORT 4

NAVY PRESENT VALUES IN STARTUP YEAR DOLLARS REPORT 5

NAVY LEVELIZED COSTS IN STARTUP YEAR DOLLARS

THIRD PARTY FINANCED/NAVY OPERATED VENTURE

REPORT 6

INVESTOR CASH FLOWS DURING CONSTRUCTION PERIOD **REPORT 7**

INVESTOR CASH FLOWS DURING OPERATING PERIOD REPORT 8

NAVY CASH FLOWS DURING OPERATING PERIOD

THIRD PARTY FINANCED/THIRD PARTY OPERATED (ALL PRIVATE) VENTURE

REPORT 9

PRIVATE VENTURE
CASH FLOWS
DURING CONSTRUCTION
PERIOD

REPORT 10

PRIVATE VENTURE CASH FLOWS DURING OPERATING PERIOD REPORT 11

PRIVATE VENTURE
MINIMUM REVENUE
REQUIREMENTS
DISCOUNTING WITH
WEIGHTED COST OF
CAPITAL

REPORT 12

PRIVATE VENTURE
MINIMUM REVENUE
REQUIREMENTS
DISCOUNTING WITH
RETURN ON EQUITY

SUMMARIES

REPORT 13
NAVY FINANCED/
NAVY OPERATED
VS

THIRD PARTY FINANCED/NAVY OPERATED REPORT 14

NAVY FINANCED/ NAVY OPERATED VS

THIRD PARTY FINANCED/

Figure 2-1 COAL-USE ECONOMICS METHODOLOGY REPORTS

Table 2-1

COMPARISON OF FINANCIAL STATISTICS USING NAVY AND COMMERCIAL ECONOMICS FOR A TYPICAL COAL-USE PROJECT⁽¹⁾

Statistics (in 1982 display year dollars)	Units	Navy Financed/ Navy Operated Venture(2)	Privately Financed/ Privately Operated Venture(3)
Present Value of Life Cycle Costs	10 ³ \$	68,121	87,114
Unit Present Value of Life Cycle Costs		3.11	3.97
Levelized Cost (constant dollar)	10 ³ \$/y r	11,518	12,024
Unit Levelized Cost	'\$/10 ⁶ Btu	13.13	13.70
Savings/Investment Ratio	dimensionles	s 6.2	6.1
Discounted Payback Period	years	4.1	4.0
Unit Levelized Cost Details (\$ per 10 ⁶ Return Required by Investors Corporate Income Tax Property Tax and Insurance Total Capital Charge Operating Labor Operating Material	Btu of stees	H/A H/A H/A 3.13 ⁽⁴⁾ 1.94	2.67 0.50 0.33 3.50 1.94
Coal (5)		6.24	6.48
Purchased Auxiliary Energy Electricity (5) Fuel Oil (5) Hetural Gas (5) Steam (5) Total Operating Cost		0.67 0.08 0.09 0.05 10.40	0.70 0.09 0.10 <u>0.05</u>
Total Levelized Cost		13.53	14.19
		-	=

(1) The project is installation of a new 200,000 lb/hr stoker boiler central steam plant with a 1987 startup year and operation for 25 years at 50 percent load factor. Costs in 1982 display year dollars are as follows:

Construction	\$21,722,000
Startup	\$ 2,383,000
Annual Coal	\$ 2,761,000
Other Annual Operating and Maintenance Costs	\$ 3,179,000

- (2) Present values are calculated with Newy economics using a constant dollar discount rate of 10 percent per year.
- (3) Present values are calculated with commercial economics using a current dollar discount rate (weighted cost of capital) of 15.9 percent per year in the presence of 6 percent per year general inflation.
- (4) The Navy analysis leads directly to a capital charge, and does not calculate return and taxes separately.
- (5) Annual differential inflation rates for purchased energy are as follows (Reference 1-5):

Coal	5 percent/year
Electricity	6 percent/year
Natural Gas	10 percent/year
Fuel Oil	8 percent/year
Steam .	6 percent/year

Section 3

THE COAL-USE ECONOMICS METHODOLOGY

The coal-use economics methodology was developed to assess the economic merits of projects to replace oil or gas with coal as steam generator fuel at Navy shore bases. As shown in Figure 3-1, the methodology uses cost estimates as input to produce financial statistics and reports as output.

In this section, the economic analysis methods and assumptions of the methodology are described in a way that highlights similarities between Navy and commercial financial analyses. The following subjects are discussed:

- Input data reformulation, dealing with adjustment of the cost estimate reference time
- Treatment of discounting and inflation, dealing with present values, levelized costs, general inflation, and differential escalation
- <u>Life cycle cost analyses</u>, dealing with closed form annuity calculations, producing the following coal-use project financial statistics:
 - Total present value
 - Unit present value
 - Levelized costs

execute executes executed parameter becomes the control of

- Unit levelized costs
- Private sector income taxes
- Analyses of costs and benefits, dealing with year-by-year calculations to produce the following financial statistics:
 - Savings/investment ratio
 - Discounted payback period
 - Simple payback period

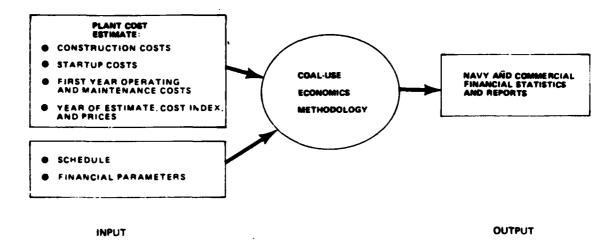


Figure 3-1 OPERATION OF THE COAL-USE ECONOMICS METHODOLOGY

 Ventures analyzed and reports generated, dealing with venture structures with combination of Navy and private interest participation in the financing and operation of the project

3.1 INPUT DATA REFORMULATION

3.1.1 Reference Times

The coal-use economics methodology works with the following three reference times:

- Base year the year of the plant cost estimate
- Display year a year chosen by the user for presentation of financial statistics
- Startup year the year of plant startup

The user must specify the base year by providing the following cost parameters: plant cost index, hourly labor rate for operation and maintenance, and prices for purchased coal, electricity, fuel oil, natural gas, and auxiliary steam. These cost parameters are input by the user along with the cost estimate for plant installation and operation.

The display year and the startup year are selected by the user and are used as reference times for present value calculations in the financial analyses. To specify the selected display year, the user must input the

following cost parameters: plant cost index, hourly labor rate for operating and maintenance, and prices for purchased coal, electricity, fuel oil, natural gas, and auxiliary steam.

The user is free to select a preferred plant cost index system, but once selected, the same system must be used in a given analysis.

3.1.2 Adjustment of Cost Estimate Reference Times

The first step in the coal-use economics methodology is the conversion of the input cost estimate from base year dollars to display year dollars. This conversion (or reformulation) is performed in the following way:

- A ratio is formed for each cost parameter between the display year value (in the numerator) and the base year value (in the denominator).
- Construction, startup, and first year operating and maintenance material costs in the cost estimate are multiplied by the ratio of the plant cost indices for the display year (in the numerator) and the base year (in the denominator).
- Similarly, the first year purchased energy costs in the cost estimate are multiplied by the corresponding ratio of energy prices.

3.2 TREATMENT OF DISCOUNTING AND INFLATION

Once the cost estimate is available in display year dollars, the methodology then distributes the capital and first year costs to their year of occurrence in plant construction and operation, and then discounts the costs to their present values at a "Year O" reference time (the display ear or startup year, depending on the section of the code). In performing the calculations, the methodology makes frequent conversions between startup year and display year costs. In all of the calculations, user specified rates of inflation and differential inflation are taken into account.

3.2.1 Present Values

The coal-use economics methodology includes calculation of present values with a Navy discount rate and two different private sector discount rates, all of which can be set by user input:

- Navy discount rate an opportunity cost which includes the equivalent of the return required by investors and an allowance for the capital charge associated with corporate income taxes.
- equity holders require on the equity portion of a private sector investment.
- Weighted cost of capital the weighted average of private sector interest on debt and return required by equity holders. The weighted cost of capital is calculated from inputs of debt fraction, interest, and return on equity.

The present value of a construction period cash flow is the product of the amount of the cash flow and the discount factor for the year in which the cash flow occurs. According to the type of structure, the following conventions are used in the methodology for timing a cash flow for a given year:

- Navy convention the cash flow is distributed uniformly over the year
- Commercial convention the cash flow is assumed to occur at the end of the year

The discount factor formulas for cash flow used by the methodology are different in the two timing conventions.

The coal-use economics methodology includes closed form calculations of the present value of a stream of equal cash flows recurring annually for N years, known as annuity. The total present value of an annuity is calculated as the product of the first year cash flow and a "cumulative uniform series" discount factor.

3.2.2 Levelized Costs

The present value statistic is also converted by the coal-use economics methodology into a financially equivalent annuity known as levelized cost. Unit levelized costs (in dollars per million Btu of energy) are convenient because they can be validly compared with current prices for purchased energy in a noninflationary period. Navy levelized costs are discussed in Reference 1-2. Private sector levelized costs, also known as minimum revenue requirements, are discussed in References 3-1 and 3-2.

The levelized cost is the best statistic for comparing Navy and commercial economic analyses, because in levelized costs the effects of differing discount rates are minimized.

3.2.3 Effects of General Inflation

STATES WANTED STATES AND STATES OF THE STATE

In the coal-use economics methodology, a user-specified general inf'/cion rate is assumed to remain constant throughout the life of a project to install and operate a plant.

To separate cost effects resulting from inflation from those which are independent of inflation, the coal-use economics methodology distinguishes between costs in "current dollars" and those in "constant dollars":

- Current (inflating) dollar costs reflect changes which are to be paid at the time the costs are incurred. During inflationary periods, the prices of most commodities rise over time, so annually recurring costs will rise at or near the general inflation rate when expressed in current dollars.
- Constant (real) dollar costs reflect amounts that would be paid if the general prices and wage levels of a specific "Year 0" remained constant over time, as if general inflation were "turned off" at Year 0.

The coal-use economics methodology relates the discount rate in current dollars to the discount rate in constant dollars according to the relation:

$$(1 + r_{cur}) = (1 + r_{const}) (1 + g)$$

where:

STATES BUILDING STATES PROPER REPORTE STATES ARTHUR COSTS

r_{cur} = current dollar discount rate

r_{const} = constant dollar discount rate

g = rate of general inflation

Table 3-1 compares typical current dollar and constant dollar discount rates for the three types of discount rate when there is a 6 percent per year general inflation.

Table 3-1

TYPICAL CURRENT DOLLAR AND CONSTANT DOLLAR DISCOUNT RATES FOR 6 PERCENT PER YEAR GENERAL INFLATION

Type of Discount Rate	Current Dollar Discount Rate, percent/year	Constant Dollar Discount Rate, percent/year
Return on Equity	18.00	11.1
Weighted Cost of Capital	15.90 ⁽¹⁾	9.3
Navy	16.60	10.0

(1) The 15.90 percent per year value represents a project capital structure containing 70 percent equity paying 18 percent per year and 30 percent debt paying 11 percent per year.

Present values at a Year 0 are calculated by either of the following methods when inflation is present:

- Costs in current dollars are discounted at the current dollar discount rate.
- Costs in constant dollars referenced to Year 0 are discounted at the constant dollar discount rate.

The present values calculated by the two methods are identical and the coal-use economics methodology uses the two methods interchangeably.

Consistent with Navy convention, levelized costs are calculated in constant dollars in the coal-use economics methodology. Also, constant dollar levelized costs are convenient because they can be readily compared with Year O purchased energy prices.

Startup year present values are converted to display year present values in the methodology by discounting at the current dollar discount rate. Startup year levelized costs are converted to display year levelized costs by de-escalating at the general inflation rate.

3.2.4 Differential Inflation of Purchased Energy

To accommodate purchased energy prices which may increase faster than general inflation, the coal-use economics methodology allows specification of a separate differential inflation rate (DIR) for each purchased energy commodity. The DIR is approximately the amount by which the commodity inflation rate exceeds the general inflation rate, and it is defined exactly by the relation,

$$DIR = \frac{1+e}{1+g} - 1$$

Here,

- e = energy commodity inflation rate, percent per year
- g = general inflation rate, percent per year

Typical DIR values for various purchased energy commodities are given in Table 3-2. The methodology combines the DIR with the constant dollar discount rate "r" to obtain an effective discount rate "x" through the formula,

$$x = \frac{1+r}{1+DIR} - 1$$

This formula, the basis for tabulated discount factors in Reference 1-1, is used in both Navy and commercial life cycle cost analyses.

Table 3-2

TYPICAL DIFFERENTIAL INFLATION RATES

FOR ENERGY PURCHASED BY NAVY BASES

Type of Purchased Energy	Differential Inflation Rate (DIR)(1), percent/year		
Coal	5		
Electricity	6		
Steam ·	6		
Fuel Oil	8		
Natural Gas	10		

(1) The DIR values shown are those recommended in Reference 1-5.

3.3 PROJECT LIFE CYCLE COSTS

The coal-use economics methodology calculates the following four economic statistics from the costs of plant construction and operation:

- Present value
- Unit present value
- Levelized cost
- Unit levelized cost

These calculations consider only costs, and do not consider cash flows of income for sale of the products of the plant. The resulting financial statistics are called life cycle costs. In the private sector analysis they measure the minimum revenues the plant must earn through sale of products to pay all expenses and taxes and to pay investors the minimum return that they require. The Navy analysis leads to comparable life cycle costs.

Figure 3-2 is the cost cash flow diagram for a typical coal-use project for calculations with Year 0 as the startup year.

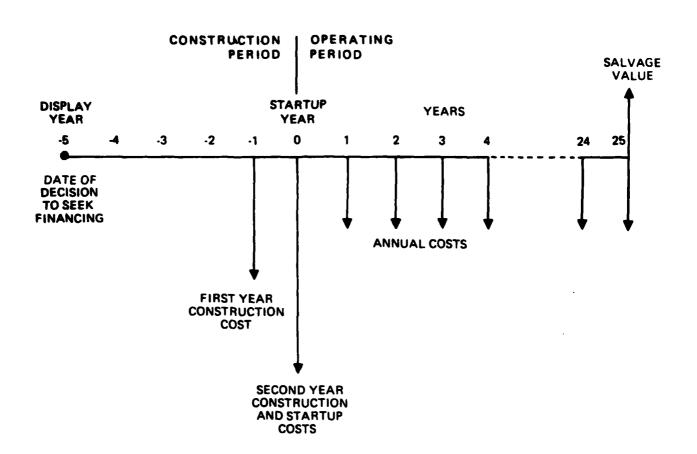


Figure 3-2 TYPICAL COST CASH FLOW DIAGRAM OF COAL CONVERSION PROJECTS

Construction period costs include the year-by-year construction costs and the startup (or owner's) costs incurred the last construction year. In commercial economic analyses, construction period costs are reduced by an investment tax credit. The present value of all construction period cash flows in startup year dollars is the total capital investment for the project.

Operating period costs, treated separately by the methodology, include the following cost items:

- Operating and maintenance labor
- Operating and maintenance materials
- Coal
- Auxiliary electricity
- Auxiliary oil
- Auxiliary natural gas
- Auxiliary steam

The present values of the operating period costs are calculated and summed to yield a total present value for operating and maintenance. The methodology assumes that the plant will operate at the same load factor each year of its specified economic life.

If there is salvage value at the end of the operating period, its present value is a negative entry in computing the total present value of project costs.

Levelized life cycle costs are calculated from the construction period present values and the operating period present values. The resulting costs associated with the investment appear as annual capital charges added to the levelized annual operating and maintenance costs.

The capital charge has similar magnitude in Navy and commercial economics, but it is calculated differently in the two analyses:

- In Navy economics, the capital charge is simply the levelized cost of the present value of the investment.
- In commercial economics, the capital charge is the sum of the following operating period levelized costs:
 - Return to equity holder
 - Debt service
 - Corporate income taxes
 - Property taxes and insurance

The methodology includes property taxes and insurance for privately operated ventures but not for Navy operated ventures, since local taxes are not levied on government land, and insurance is not usually included in Navy economic analyses. The annual property tax and insurance are typically 2 percent of the total capital requirement.

3.4 PRIVATE SECTOR INCOME TAXES

When calculating commercial minimum revenue requirements, the coal-use economics methodology calculates federal and state corporate income taxes as a function of the minimum revenue requirement for return to investors (the "after-tax cash flow") by the following tax formula:

$$T = \frac{t}{1-t} \quad (A - D - I)$$

where

T = annual corporte income tax

t = the tax rate, typically 50 percent

A = annual after-tax cash flow

D = annual capital depreciation for tax purposes

I = annual interest paid on debt

Since capital depreciation and interest payments vary from year to year, the methodology performs a year-by-year calculation to determine the

corresponding tax and its present value. The total life cycle present value of income tax is obtained by summation.

The capital depreciation for tax purposes is calculated in the coal-use economics methodology by one of the following two methods, specified by the user (and summarized in Table 3-3):

- Sum-of-the-Years-Digits (SOYD), in use for several decades
- Accelerated Cost Recovery System (ACRS), introduced recently

The methodology calculates interest on debt on a year-by-year basis assuming constant annual payments for debt service (the sum of interest and principal).

The methodology permits the user to specify a percentage for an investment credit to reduce income tax during the construction period. This credit is subtracted from the total capital requirement to obtain the actual cost to investors.

3.5 ANALYSES OF COSTS AND BENEFITS

In addition to calculating the life cycle costs of a coal-use project, the methodology compares the coal-use project with burning oil or gas in existing boilers in a year-by-year analysis of costs and benefits. The analyses of costs and benefits are carried out to calculate comparison financial statistics, which are the savings/investment ratio and payback periods.

3.5.1 Navy Comparison Statistics

In the Navy analysis, the operating costs that would be paid for the oilor gas-burning unit are calculated as benefits to the coal-use project, since the coal-use project. The benefits occur during the operating period when oil or gas is displaced by the coal-use project. The

Table 3-3

22222 | 122223 | 122222 | 122222 | 122222

NETHODS FOR CALCULATING CAPITAL DEPRECIATION FOR TAX FURPOSES

Item	Hethod 1 - Sum of the Yearm Digits	Method 2 - Accelerated Capital Recovery System
Definition of Tax Depreciable Capital Motation TDC = Tax Depreciable Capital, dollars CC = Construction Cost, dollars IDC = Interest Daring Construction, dollars SC = Startup (Owner's) Costs, dollars ITC = Investment Tax Credit, dollars(1)	TDC = CC + IDC + 0.4 SC	TDC = CC + IDC + 0.4 SC - 0.5 ITC
Motation Notation Notation ADD - Annual Depreciation Deduction, dollars TDC = Tax Depreciable Capital, dollars DF = Depreciation Factor N = Depreciation Life, years n = Year of Payment	ADD = TDC · DF DF = $\frac{N-n+1}{N(N+1)/2}$ for $n \le N$ DF = 0 for $n > N$	ADD = TDC · DF Table of Depreciation Pactors (DF) Year of Peyment n W 1 2 3 4 .5 6 7 8 9 10 11 12 13 14 15 3 .25 .38 .37 0 0 0 0 0 0 0 0 0 0 0 0 5 .15 .22 .21 .21 .21 0 0 0 0 0 0 0 0 0 0 10 .08 .14 .12 .10 .10 .10 .09 .09 .09 .09 0 0 0 0 15 .05 .10 .09 .08 .07 .07 .06 .06 .06 .06 .06 .06 .06 .06
Depreciation Life Selection	N may be any integer	Allowed values of N are 3, 5, 10, and 15 Methodology selects next lower allowed N if input N is between allowed N N = 3 applies to vehicles N = 5 applies to third party and most private ventures N = 10 and N = 15 apply to utilities and long-life private ventures

⁽¹⁾ Startup (Owner's) costs are assumed to include 40 percent depreciable capital and 60 percent nondepreciable capital.

⁽²⁾ In the accelerated capital recovery system, half the investment tax credit must be subtracted in computing depreciable capital.

year-by-year annual savings caused by the coal-use project are then calculated as the difference between the annual benefits and the annual coal-use project operating and maintenance costs. The present values of the savings in each year are then calculated. The methodology finally calculates the savings/investment ratio and discounted payback period financial statistics in the following ways in the Navy analysis:

- The savings/investment ratio is the ratio of the total present value of savings to the total present value of the investment. If the savings/investment ratio exceeds 1.0, the coal-use project is financially attractive.
- The discounted payback period is the time until the cumulative present value of the savings becomes equal to the present value of the investment. If the discounted payback period is less than the operating life, the project is attractive.

3.5.2 Commercial Comparison Statistics

In the commercial economic analysis, the operating costs for burning oil or gas are considered as revenues for the coal-use project, under the assumption that the products of the coal-use project could be sold for the price of making them by burning oil or gas. The equivalent of "savings" in commercial economics is the after-tax cash flow.

The coal-use economics methodology makes calculations of both of the following commercial economic equivalents of savings:

- The after-tax cash flow (common in the regulated electric utility industry)
- The equity after-tax cash flow (common in unregulated industries, such as petroleum)

The after-tax cash flow is:

$$A = (1 - t)(R - E) + tD + tI$$

where

- A = annual after-tax cash flow
- t = the tax rate
- R = total annual revenues
- E = annual expenses
- D = annual capital depreciation for tax purposes
- I = annual interest paid on debt

In the after-tax cash flow analysis of the methodology, the present value of each annual after-tax cash flow is calculated year by year using the weighted cost of capital as the discount rate. Then the methodology calculates savings/investment ratio, discounted payback period, and simple payback period financial statistics:

- The savings/investment ratio is the ratio of the total present value of operating period after-tax cash flows to the present value of the investment. As before, the coal-use project is economically attractive if the savings/investment ratio is greater than 1.0.
- The discounted payback period is the time until the cumulative present value of the after-tax cash flows becomes equal to the present value of the investment.
- The simple payback period is the time until the cumulative after-tax cash flow becomes equal to the present value of the investment.

The equity after-tax cash flow analysis in the methodology differs from after-tax cash flow analysis in the following ways:

- The equity after-tax cash flow equals the after-tax cash flow minus debt service.
- Only the equity portion of the investment is used to compute the savings/investment ratio and payback periods.
- The discount rate is the return on equity.

3.6 VENTURES ANALYZED AND REPORTS GENERATED

The methodology was constructed to accommodate three different venture structures. These are:

- Navy financed/Navy operated venture
- Third party financed/Navy operated venture
- Third party financed/third party operated (all private) venture

For the all-Navy venture, results are presented in both display year dollars and startup year dollars to conform to two different conventions followed in the Navy. For the all-private venture, minimum revenue requirements are presented in display year dollars using both return on equity and the weighted cost of capital as discount rates to provide financial statistics appropriate for both regulated and unregulated industries.

Section 4

AUTOMATION OF THE COAL-USE ECONOMICS METHODOLOGY

The coal-use economics methodology, described in detail in Section 3, was automated by construction of the Phase I computer program, entitled "COALR - Coal Conversion Cost Reformulation Program." Adapted from the Reference 1-6 computer program, the COALR program has the following features:

- INFREE free-format input data interpretation, retained from the Reference 1-6 computer program
- Routines to recognize and store user input plant, utility, and Navy economic parameters
- A routine to recognize and store user input on coal-use costs to be reformulated, fuel to be displaced, and commercial economic parameters
- An interpretive input echo routine to assure storage of input in correct internal variables
- A routine to reformulate input coal-use costs to a display year dollar basis
- A routine calculating Navy present values and levelized costs, retained from the Reference 1-6 program
- Routines to perform cost and benefit analyses using Navy economics
- Routines to calculate third party and private venture financial statistics using commercial economics

Details of the COALR program are described in the user's manual, which is issued separately (Ref. 4-1). This section explains the reports produced by this program. As indicated in Figure 2-1, the program produces 14 cost reports. A group of five reports displays the financial statistics for Navy financed/Navy operated projects. A second group of three reports covers third party financed/Navy operated projects. The third group of four reports covers third party financed/third party operated (all private) projects. Finally, there are two summary reports providing

financial comparisons of the third party financed/Navy operated and the third party financed/third party operated (all private) projects with the Navy financed/Navy operated base case. The program always produces the statistics for the base case. The user selects one of the other scenarios for the run.

In subsequent portions of this section, the 14 cost reports are explained by samples produced for a stoker-fired central steam plant. The plant was assumed to have the following characteristics:

Plant capacity, lb/hr steam	200,000
Average load factor, %	50
Plant economic life, years	25
Startup year	1987
Display year	1982
Costs (fourth quarter 1982 dollars)	
- Construction	21,722,000
- Startup	2,383,000
- Annual coal supply	2,600,000
- Annual O&M costs	3,179,000

The reports were produced in two runs of the program: the first, specifying a third party financed/Navy operated commercial venture, and the second, specifying a third party financed/third party operated commercial venture. All other input information is identical for the two runs.

4.1 NAVY FINANCED/NAVY OPERATED VENTURES

This section describes the reports generated by the coal-use economics methodology for a typical venture that is Navy financed and Navy operated.

4.1.1 Report 1 - Navy Present Values in Display Year Dollars

Table 4-1 shows Report 1, which gives Navy present values in display year dollars. For the sample case, the display year was selected to occur 5 years before plant startup. Reading rows from the top, the report provides year-by-year costs during the construction and startup period.

Table 4-1

Report 1 -

		NAVY PRESENT VA	NAVY PRESENT VALUES IN DISPLAY YEAR DOLLARS	YEAR BOLLARS .	
		COST (1000 \$)	11SCOUNT FACTOR	PRESENT Value (1000 s)	UNIT PRESENT VALUE **
CONSTRUCTION	1986	8037.	.7166	5759.	• 26
CONSTRUCTION	1987	13685.	.6515	8915.	. 41
TOT AL CONSTRUCTION	0 0 0 1 0 0			14675•	.67
STARTUP	1987	20.83.		1552.	
1987 - 2012					
LABOR		1703.	5.9135	10068.	9**
OPERATING + MAII MATERIAL	a in tenance	1162.	5.9135	6874.	. 31
ELECTRICITY		256.	13.5466	3472.	.16
6A S		19.	25.0000	487.	.02
STEAM		17.	13.5466	233.	.01
011		23.	18.2936	420.	- 02
COAL		2762.	11.710A	32342.	1.48
		6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6		70123	3.20
101 AL		•			

. ALL COSTS AND PRESENT VALUES ARE PFFEPFINCED TO THE DISPLAY DATE OF NOVEMBER 1982 .. 21900. BILLION STUS OF HEST ARE TRANSFERRED IN 25.0 YEARS OF OPERATING LIFE

It then treats each distinct category of annual operating and maintenance cost as a separate annuity. Finally, it provides total costs.

The first column of the report contains costs in display year dollars. For construction and startup, the costs are the constant dollar equivalent of actual project cash flows. For the operating period, the costs are first year costs expressed in display year dollars.

The second column contains discount factors for the construction and operating periods. Construction period discount factors are for one-time cash flows. Operating period discount factors are cumulative uniform series discount factors that account for all years of plant operation. The discount factors are based on the constant dollar discount rate with adjustments for differential inflation.

The third column contains present values formed as the product of first column costs and second column discount factors.

The fourth column contains unit present values formed by dividing the third column present values by the number of Btu's of heat transferred (supplied to steam) over the project operating life.

4.1.2 Report 2 - Navy Levelized Costs in Display Year Dollars

Table 4-2 shows Report 2, which gives constant dollar Navy levelized annual costs in display year dollars. The row headings are identical to those in Table 4-1. The cost column is also identical to that in Table 4-1. The second column contains levelizing factors derived directly from the discount factors in Table 4-1. Each levelizing factor is the quotient formed by dividing the corresponding discount factor by the discount factor for operating material cost. The third column in Table 4-2 contains levelized costs formed as the product of first column costs and second column levelizing factors. The levelized cost is expressed in display year dollars. The fourth column contains unit levelized costs formed by dividing third column levelized costs by the number of Btu's of heat transferred in one year of operation.

Table 4-2

Report 2 -

MAVY LEVELIZED COSTS IN DISPLAY YEAR BOLLARS

		COST (1000 \$)	LFVEL17 ING FACTOR	LEVEL12ED COST (1000 \$)	UNIT LEVELIZED COST s/MILLION RTU	
CONSTRUCTION	1986	80%7°	.1212	974.	1.11	
CONSTRUCTION	1987	13685.	-1102	1506.	1.72	
TOTAL CONSTRUCTION		21722.		2442.	2 . 6 3	
STARTUP	1981		.1102	263.	0 E •	
1987 - 2012						
LABOR		1763.	1.000 €	1703.	1.94	
OPERATING + MAINTEP MATERIAL	TENANCE	1162.	1.0000	1162.	80°4	
ELECTRICITY		256.	2.290 &	587.	.67	
6A S		19.	4.2276	82.	60.	
STEAM		17.	2.2908	39.	•0•	
011		23.	3.0435	11.	80.	
1 0 0 T		2762.	1.9804	5469.	.6.24	
TOT AL			1 1 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0	11858.	13.54	-

⁺ ALL COSTS ARF REFERENCED TO THE DISPLAY DATE OF NOVEMBER 1982

^{** 876.00} HILLION BIUS OF HEAT ARE TRANSFERRED ANNUALLY

4.1.3 Report 3 - Navy Cost and Benefit Analysis

Table 4-3 shows Report 3 for a Navy economics cost and benefit analysis. The analysis involves a year-by-year calculation carried out with constant display year dollars. The first column indicates the year for the costs considered. The second and third columns repeat investment cash flow information from Reports 1 and 2.

The operating costs column contains the total operating and maintenance cost of the coal-use project for each year. Each entry is the sum of labor, material, and energy costs. The energy costs are differentially escalated before they are added to form the sum. The operating benefits column contains similar total operating and maintenance costs for the alternative oil-fired project. The savings column entries are the differences between the corresponding operating costs and operating benefits.

The present value discount factor column contains discount factors formed with the constant dollar discount rate. Present values for investment, operating costs, and savings are then given in the remaining three columns. The present values are formed by multiplying the discount factor times the corresponding cash flows. The year-by-year calculation of operating cost present values yields a total operating cost present value that is within 0.06 percent of the sum of operating period present values in Report 1. This small difference arises because the year-by-year analysis utilizes an approximation to the Report 1 uniformly distributed discount factor with differential inflation.

At the bottom of the report, the financial statistics derived from the analysis are presented. The present value, unit present value, levelized cost, and unit levelized cost for the coal-use project are presented. Then the savings/investment ratio and the discounted payback period derived from comparison with oil-firing are presented.

CANACA SECURITY REPRESENT SECURITY LINES.

MANY COST AND BENEFIT ANALYSIS (THOUSANDS OF DISPLAY YEAR FOLLARS)

Table 4-3	ING. PV O			1564. 1760.			2972. 5997.	25. 4051.			0004	4071		2045	1654. 4027.	3980		3923			3785		03. 98739	BILLION BTU)
Report 3 - Report 3 - Report 3 - Report 3 - (TINDUSANIS OF DISPLAY TEAR FOLLARS) (TINDUSANIS OF DISPLAY TEAR FOLLARS) (OPTRATING PRESENT CONSTRUCT (OPTRATING PRESENT PROFEST CONSTRUCT (OPTRATING		:	•	א מי	33	20		26.	2	23	23	7 6	81	11	- - -		13	13	12	7 :			5390	_
Table 4-3 Report 3-	÷ C	: -)																				16227	1 .
Table 4- Report 3 Report 4 Report	NALVSIS PRESENT VALUE DISCOUNT	.717	. 592	6.53	. 4 4 5	• + 05	. 368	•	.276	.251	.278	6 E I .	.172	.156	. 142	1117	.107	160.	. 0 .	0 . 0	0.00	090	• • • • •	/ 219
COMSTRUCT STAPTUP OPERATING OPERATING OFFATING OPERATING OFFATING OPERATING	able 4-3 eport 3 - splay yran splay yran coprating		6242.	7020	8785			13329	4720	16229.	17868.	21578	23668	25939	28402	33969	\$7109.	40512.	44202	47200	7007	62315	651133	9 T E
COMSTRUCT STAPTUP OPERATING CONSTS COSTS AR COSTS COSTS COSTS AR COSTS	OF AND		13163.	14150.	16368.	17610.	18953.	21967	23656	25481.	27451.	31875	34356.	37034	39976.	45.422	50063	53996.	58742.	62R27.	71128	78899.	590	THOUSAND FFR WILLION THOUSAND PFR WILLION
COMSTRUCT STAPTUP AR COSTS COSTS AR ART ART	PAA (11:50; 		6921.	7130.	7582	7826.	308%	1000 F	8937	9252	9583	100000	10687	11095.	11524.	12453	12955	13483.	14040	14627	15897	-	270457	\$ 70130. \$ 3.20 \$ 11859.
COMSTRUC AR COSTS COSTS COSTS AR COSTS AR	STAPTUP	24.83																					2383	10
7.2	COMSTRUCT	13685																					1722	ALUE OF FNT VAL COST
		1986	1988	1989	1991	1992	5	, 0	. 6	1997	1998	•	•	0	0	5 6	2	•	0	ο,	-		0	SERT 1 PR EL17

+ DV FENDTES PRESENT VALUE

4.1.4 Reports 4 and 5 - Startup Year Dollar Tables

Table 4-4 shows Report 4, which contains Navy present values in startup year dollars. Table 4-5 shows Report 5, which contains Navy levelized costs in startup year dollars. Reports 4 and 5 are identical in form to Reports 1 and 2, respectively. To generate the startup year reports, investment and first year operating and maintenance costs are converted from current dollar display year costs to current dollar startup year costs, using general inflation and differential inflation escalation factors.

4.2 THIRD PARTY FINANCED/NAVY OPERATED VENTURES

This section describes the reports generated by the coal-use economics methodology for a typical venture that is third party financed and Navy operated.

4.2.1 Report 6 - Investor Cash Flows During Construction Period

Table 4-6 shows Report 6, which contains a year-by-year analysis of construction period financing by third party investors. The analysis is carried out in current dollars. Present values are calculated in startup year dollars.

The top table of the report establishes the investment present value at startup. Successive columns describe sources and uses of funds, tax savings and tax credits, the after-tax equity cash flow, and present values for total investment and the equity portion. The split between debt and equity is in accord with user input. Tax savings and credits during the construction period reduce the equity cash flow required during construction. The capital cost during the last construction year contains both the final year construction costs and the startup costs.

The bottom table of the report establishes the tax basis for tax depreciation during the operating period. Successive columns show: the depreciable portion and total investment, interest on debt, a tax credit adjustment to the tax basis, and the resulting tax basis.

Table 4-4

Report 4 -

		NAVY PRESENT VA	MAYY PRESENT VALUES IN STARTUP YEAR BOLLARS .	YEAR BOLLARS .	
		COST (1000 \$)	DISCOUNT	PRESENT VALUE (1008 S)	UNIT PAESENT VALUE **
CONSTRUCTION	1986	10755.	1,1541	12413.	-57
CONSTRUCTION	1981	18313.	1.0492	19214.	8 0
TOTAL CONSTRUCTION		29048	0 1 e e b b b b b b b b b b b d å å b b	31627.	
STARTUP	1981	7 6 6 7 7 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	7.040.	9600	•15
1967 - 2012					
LABOR		2278.	4.5237	21698.	66.
OPERATING + MAIN	HAINTENANCE L	1556.	4.5237	14814.	99•
ELECTRICITY			16.3028	7484.	***
648		42.	25.0009	1050.	• 05
STEAN		31.	16.3028	501.	• 02
011		45.	26.0587	•906	*0*
COAL		4717.	14.7776	69704.	3.18
707 AL	1 5 6 8 8 8 8	2 6 6 1 1 1 1 1 1 1 1 1 1	; ; ; ; ; ; ; ;	151131.	06.9

. ALL COSTS AND PRESENT VALUES ARE REFERENCED TO THE STARTUP DATE OF NOVEMBER 1987

21988. BILLION PTUS OF HEAT APE TRANSFERPED IN 25.0 YEARS OF OPERATING LIFE

Table 4-5

Report 5

NAVY LEVFLIZED COSTS IN STARTUP YEAR DOLLARS +

		1200	LEVEL121NG Factor	LEVELIZED COST (1000 \$)	UNIT LEVELIZED COST ** \$/#1LL10N BTU	
CONSTRUCTION	1986	10755	.1212	1303.	1.49	
CONSTRUCTION	1987	18313.	.1102	2018.	2.30	
TOTAL CONSTRUCTION		2906A.	8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	3321.		
STARTUP	1987	9220	.1102 351.	351.	•	
1987 - 2012						
LABOR		22 7 A.	1.0000	2278.	2.60	
OPERATING + MAINTE! Material) TE NANCE	1556.	1.0000	1556.	1.76	
ELECTRICITY		459.	1.7116	786.	•••	
6AS		12.	2.6250	110.	•13	
STEAM		31.	1.7116	53.	90.	
011		45.	2.1054	95.	.11	
COAL		4717.	1.5517	7319.	B. 36	
T01AL		0 0 0 0 0 0 0 0 0 0	8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	15869.	18.12	-

[.] ALL COSTS ARE REFERENCED TO THE STARTUP DATE OF NOVEMBER 1997

^{** 876.00} FILLION RTUS OF HEAT ARE TRANSFERRED ANNUALLY

Table 4-6

MANAGE STATEMENT OF THE STATEMENT OF THE

Report 6-

THIRD PARTY FINANCED/NAVY OPERATED VENTURE: INVESTOR CASH FLOWS DURING CONSTRUCTION PERIOD (THOUSANDS OF DOLLARS)

VALUE TOTAL	MYL S 1MLM 1	10563.	19376.	29958.	
4 4			•		
PRESENT VALUE	PORTION INVESTMENT	7184.	13159.	20343.	
AFTER TAX EQUITY	CASH FLOW	6 08 8 .	13159.	19247.	YEAR
7 88	•	1015.	1959.	2974.	TUP BASED ON RETURN ON EQUITY = 14.00 PERCENT PER YEAR
TAX SAVINGS FROM IDC	DEDUCTION	•	167.	167.	= 14.00 P
	USES	10147.	21837.	319A3.	ON EQUITY
FUNDS	ON DEAT	0	335.	335.	ON PETURM
USE OF FUNDS	COST ON DEAT	10147.	21502. 335.	31648.	PTUP BASED
SOURCE OF FUNDS	E9U3 TV	7103.	15286.	22388.	. PRESENT VALUE AT START
SOURCE	DERT	3044	6551.	101AL 9595.	RESENT VA
	EAR	986	987	TOTAL	•

PRESENT VALUE AT STARTUP BASED ON VEIGHTED COST OF CAPITAL = 15.90 PERCENT PER YEAR

n		
-	•	
0	S	i
-	•	ě
	=	į
_	LARSI	ï
_	מסרר	:
3	=	•
3	9	;
-	0	•
		•
•	•	•
Ō	6	
>	6	****
5	ö	ĭ
Ξ	7	
_	Ξ	•
_		- 2
٠.	×	;
_	_	•
Ç	(THOUS ANDS	
u	T.	
J	-	•
•	•	•
ũ		

	TAX BAS1S	9639.	• • • • • • • • • • • • • • • • • • • •	28583.
TAX CREDIT	TO TAX BASIS	507.	979.	1487.
INTEREST	ON DERT	•	335.	335.
VESTMENT STARTUP)	TOTAL	10147.	21502.	31648.
FLANT INVESTMENT (INCLUDING STARTUP)	DEPRECTABLE PORTION	10147.	19589.	29735.
	YEAR	1986	1987.	TOTAL

4.2.2 Report 7 - Investor Cash Flows During Operating Period

Table 4-7 shows Report 7, which contains third party investor cash flows during the operating period. In this analysis, it is assumed that the third party investors receive uniform annual lease payments from the Navy over the 15-year life of the lease. (Note that the lease payments are uniform in current dollars; when expressed in constant dollars, they will decline over time.) At the end of the lease life, the facility becomes the property of the Navy. The lease payments must be sufficient to provide the required return to lenders and equity holders and to pay corporate income taxes. The lease payments therefore must be equal to the minimum revenue requirements shown in the second column. Subsequent columns provide the breakdown of the minimum revenue requirement and proof that the after-tax equity cash flow has a present value equal to the equity portion of the investments from Report 6.

The third and fourth columns contain the annual interest and debt service. The minimum revenue requirement minus the debt service equals the before-tax equity cash flow in the fifth column. The sixth column contains the depreciation computed for a ten year tax life by the ACRS method. The seventh column, taxable income, is the difference between the revenue requirement and the sum of interest plus depreciation. The corporate income taxes computed with a 50 percent tax rate are shown in the eighth column. The difference between the before-tax equity cash flow and the tax is the after-tax equity cash flow of the ninth column. The discount factor computed from the current dollar return on equity (ROE) is shown in the tenth column. The present value of the after-tax equity cash flow is given in the final column. By definition, the total present value agrees, within rounding, with the present value of the equity portion of the total investment of Report 6.

4.2.3 Report 8 - Navy Cash Flows During Operating Period

Table 4-8 shows Report 8, which contains Navy cash flows during the operating period. The report provides both a life cycle cost for the project and a cost and benefit comparison. The analyses are performed using Navy economics.

Table 4-7

COLUMN SOCIONA LANGE

Amountain accession to an analysis and an analysis of the contraction of the contraction

Report 7-

THIRD PARTY FINANCED/NAVY OPFRATED VENTURE: INVESTOR CASH FLOUS DURING OPERATING PERIOD (THOUSANDS OF DOLLARS)

LEVELT7ED HINIMUM		SERVICE	BEFORE-TAX	9			AFTER-TAX	PRESENT VALUE (1) AT STARTUP ROE = 16.60 PCT	ALUE (PV)
-	PORT 10N	TOTAL	CASH FLOW	1A T 10N	INCOME	TAXES	CASH FLOW	FACTOR	AMOUNT
i	105%	1534.	5019	4287.	1011.	505	4514.	.847	3825.
	1025.	1930	5019.	6288.	-969-	-480.	5499.	.718	3949
	991.	1334.	5019.	6002.	-640.	-320.	5339.	•609•	3250.
	.53.	1334.	5019.	6002	-602	-301.	5320.	.516	2744.
	911.	1334.	5019.	6002.	-260.	-280.	5299.	37	2316.
	964.	1334.	5019.	•	5489.	2745.	2275.	.370	843.
	813.	1334.	5019	ċ	5541.	2770.	2249.	.314	7.06.
	755.	1334.	5019.	•	5598.	2799.	2220.	.266	591.
	692.	1334.	5019.	•	5662.	2831.	2188.	.225	493.
	621.	1334.	5019	•	5733	2866.	2153.	.191	411.
	542.	1334.	5019.	•	5811.	2906	2114.	.162	342.
	455.	1334.	5019.	0	5898.	2949.	2070-	.137	284.
	350.	1334	5019.	•	5995.	2997.	2022	.116	235.
	251.	1334.	5019.	•	6102.	3051.	1968.	•60•	194.
	137.	1334.	5019.	•	6221.	3111.	1909	• 0 84	159.
•						1 1 1 1 1 1 1		****	
	10420.	20015.	752BB	28583.	56500.	28150.	47138.		20343

						rante 4	01				
						Report	ا «				
				THIRD P	CANT FI	INANCED/NAVY OUS DURING TOUS AND OF	OPERATED OPERATING DOLLARS)	VENTURE: Period			
	•	LFAS CURRENT DOLLARS	E COST CONSTAN DOLLAR	PV+ FACTOR FOP Lease	V OF ASE OST	PERATIN COSTS	RATI Nef I	७ ~ ~ <i>w</i>	FACT OPER COS	P V C OS	PV OF SAVINGS
	1 4	6354	4479.		• •	6921	3163	6242.		60 +	3697
			4225.	m) (49	7130.	14150.	7020-		- CO	3788.
	1990	4	40 P. C.	4	œ v	2 0	15216.	1800°	•	374	3000
		~ ~	1010	200	368	ي ب	17610	9784	•	166	3958.
	1993	3	3347	3	173	2	18953	10870.	•	2972.	3997.
٠	. 6		3158.	3	900	3	20402	12049.	•	792	926
	99	•	2979.	2	3	37	21967.	13329	•	2625.	
	•		2810.	26	2 :	3	23656.	14720	•	2194	4074
	2	63.54	2651	2:	2		• 184C2	1 707	• '	2188	9
	66	•	2501.	2	* :	2 6	- 1C P / 2	1 7660	• '	2062	879
	6	•	2359	2	5	2077	11978	21575	• •	1944	6
	0	S :	2226.		3		31010	24648	•		90
	00	*	2100.	4	?		1784	25040	•	2	5
	9 6	<u> </u>	1981		-		49996	28402	•	634	027
	3 6		•	? :	•	1977	4050	31073		4	000
	9 6		• •	7 :		, ,	46422	33969	•	159	-
) () (• •			ė	2955	50063	37109.	.10	38	-
	3 6			6	•	2	53996.	40512	•	20	3923.
	9		•	98	•	0+0+	5.8242	44202	60 •	236	
	8		•	0	•	4627	62827.	48200		171	m 4
	50			9	•	5246	1779	52533	-0.	, 101	
	5	•	•	• 063	•	G.	73125	57228.	90.	2	•
	5	•	•	.057	•	65B4	78899	ĸ.	90.	.166	_
	- 1					278464	1111100	651113		53963	98739
	TOTAL	95503	46111		۲ ۲) } i	
•	PRES	ENT VALUE	0	8 69R	. THOUS		ָּהָ .	PERAT			-
	UNIT	PRESENT	VALUE	•	9 PER 1	ILLION RIU	PV / 21	300. BILLI	io i si no		
	EVE	0321	-	&	14005	3		1641	76. B	CUTA MOT 117	
	LIND	LEVEL12E	D COST			ILLIUM PTU	(PV SAVINGS	> <	1SE)		
	7	INTEND	AR AC	• • • • • •	2 YEARS		ž	SR	FOR		
	<u>ہ</u>		משרי יורא				ರ	PV SAV	VGS	L PV LEASE)	
		DE NOT	S PRESENT	VALUE.							
	:	PRESENT V	ALUES ARE	REF	O THE D	ISPLAY VFAR.					
		71 175	104 VIVC		2		- X X X				

The top portion of the report contains cash flows and their present values. The first column contains the operating years. The project shown has a 25-year operating life. The second column contains the current dollar end-of-year lease payments from the Navy to the third party investors. Since the Navy economic analysis is carried out in constant dollars, the lease payments are first de-escalated to display year dollars, as shown in the third column. The fourth column provides constant dollar end-of-year discount factors. The fifth column provides the constant dollar present value of the lease payments obtained by multiplying the third column and the fourth column. The total present value of lease payments represents the total investment denominator in the savings/investment ratio.

The remaining columns in the upper part of the report are identical to columns in Report 3, the cost and benefit comparison for an all-Navy project. Successive columns contain operating costs, operating benefits, operating savings, the present value discount factor for savings and operating costs, and finally the present values of operating costs and savings.

The bottom of the report contains the financial statistics calculated from present values from the upper part of the report. The statistics are the same as those calculated in Report 3.

- THIRD PARTY FINANCED/THIRD PARTY OPERATED (ALL PRIVATE) VENTURES
 This section describes the reports generated by the coal-use economics
 methodology for a typical venture which is privately financed and
 privately operated. The venture involves capital and operating costs
 that are identical to those in the all-Navy venture described in
 Section 4.1.
- 4.3.1 Report 9 Private Venture Cash Flows During Construction Period

 Table 4-9 shows Report 9, which contains construction period cash flows
 for the private investors. Report 9 is identical to Report 6.

Table 4-9

Report 9 -

PRIVATE VENTURE CASH FLOWS DERING CONSTRUCTION PERIOD (THOUSANDS OF DOLLARS)

PRESENT VALUE OUITY** TOTAL* PORTION INVESTMENT	10563.	19376.	29938.	
PRESENT VALUE EQUITY** TOTAL PORTION INVESTME	7184.	13159.	20343.	
AFTER TAX EQUITY CASH FLOW	6088.	13159.	19247.	YEAR .
TAX	1015.	1959.	167. 2974. 19247.	RCENT PER
TAX SAVINGS FROM IDC DEDUCTION	•	167.	167.	= 18.00 PE
TOTAL SOURCES AND USFS	10147.	21837.	31983.	ON EQUITY
FUNDS INTEREST ON DERT	•	335.	335.	TUP BASED ON RETURN ON EQUITY = 18.00 PERCENT PER YEAR
CAPITAL INTEREST	10147.	21502.	31648.	TUP BASED
FUNDS	7103.	15286.	22388.	PRESENT VALUE AT STAR
SOURCE OF FUNDS	30 44.	6551.	TO TAL 9595.	RESENT VAL
YEAR		1987	TO TAL	1

PRESENT VALUE AT STARTUP BASED ON WEIGHTED COST OF CAPITAL = 15.90 PERCENT PER YEAR

CALCULATION OF TAX BASIS (THOUSANDS OF DOLLARS)

	PLANT IN	PLANT INVESTHENT CINCLUDING STARTUP)	• • •	TAX CREDIT	
YEAR	PORTION TOTA	TOTAL	INITALS I ON DERT	TO TAX	TAX
:	•			1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	
1986	10147.	10147.	•	507.	9639
1981	19589.	21592.	335	979.	18944.
TOTAL	29735.	31648.	335.	1487.	28583.

4.3.2 Report 10 - Private Venture Cash Flows During Operating Period

Table 4-10 shows Report 10, which indicates operating period cash flows for the private operators. The top half of the report is a year-by-year current dollar cost and benefit analysis for a 25-year operating life. The first column contains the operating year. Asterisks indicate that information has not been printed for some years. The next seven columns contain current dollar amounts, and the final six columns contain present values at startup.

The second column contains operating expenses which are the current dollar expenses equivalent to the constant display year dollar costs for the operating period in Report 3. The third column contains operating benefits (revenues) on the same basis. The fourth column contains operating savings formed as the difference between the third and the second columns. The fifth column contains interest payments, calculated assuming a 25-year debt life. The sixth column contains tax depreciation, which is identical to the corresponding column of Report 5 for third party investors during the operating period.

The seventh column contains the after-tax net cash flow calculated from the savings, interest, and depreciation, using Equation (3-3). The eighth column contains the after-tax equity cash flow, formed by subtracting debt service from the after-tax net cash flow.

the second teams to be and the second to the

The ninth, tenth, and eleventh columns give present values calculated using the current dollar weighted cost of capital as the discount rate. The ninth column is the present value of expenses. The tenth column is the present value of interest plus depreciation, needed for calculating the present values of taxes. The eleventh column is the present value of the after-tax net cash flow.

The twelfth, thirteenth, and fourteenth columns give present values calculated using the current dollar return on equity. The twelfth column contains the present value of expenses plus debt service. The thirteenth

NOTICE RECEDENT CHARGES THERESE

KONTON KANASAN BENKAZAZI BIRKESAN KANASAN BENKASAN KANASAN BENKASAN BENKASA

Report 10-

PRIVATE VENTURE CASH FLOWS DURING OPERATING PERIOD (THOUSANES OF DOLLARS)

PRESENT VALUE USING

PRESENT VALUE USING

				CURRENT DOL	LLARS			VE I GHT ED	ED COST OF	CAPITAL	•	RETURN ON EQUITY	IUITY **
		*				AFTER-TAX	X AFTER-TAX	-	INTEREST	AF TER-TAX	- KX	INTEREST	AFTER-TAX
	OPERAT-	OPER-	-0 340		TAX	NET	EQUITY		+ TAX	NE 7	PENSES	+ TAK	EDUITY
	ING EX-				DEPRE-	CASE	CASH	EX-	DEPRE-	CASH	+ 0E8T	DEPRE-	CASH
YEAR	PENSES	H	S	INTERFST	CIATION	F1.01	FLOW	PENSES	CIATION	FLOW	SERVICE	CIATION	FLOW
	•				* * * * * * * * * * * * * * * * * * * *							•	* * * * *
1988	10564.	19363.	8600.	1055.	4287.	7071.	5932.	9114.	4610.	6101.	9918.	4528.	5027.
1989	11484.	22068.	19584.	1046.	628A.	A959.	7820.	8549.	5460.	6670.	906	5260.	5616.
1993	12498.	2515A.	12661.	1036.	6002	9850.	8710.	8027.	4521.	6327.	6300.	4284.	5301.
1	13613.	28689.	15076.	1025.	6102.	11052.	9912.	7544.	3894.	6125.	7609.	3624.	5113.
199.2	14842.	32724.	17482.	1012.	6002.	12448.	11339.	7097	3354.	5952.	6986.	3066.	4943.
1993	16197.	37336.	21139.	.09R.	•	11069.	9929.	6682.	412.	4567.	6422.	370.	3678.
1994	17690.	42607.	24916.	982.	•	12949.	11810.	6297.	350.	4610.	5911.	308.	3707.
1995	19336	48632	29294.	965.	•	15130.	13990.	5939.	296.	4647.	5448.	257.	3722.
1996	21157.	55521.	34364	946.	•	17655.	16516.	5607.	251.	4679.	5027	213.	3724.
1997	23165.	63397.	40232.	925.	•	20578.	19419.	5297.	211.	4705.	4644.	177.	3714.
1998	25384.	72402.	47019.	901.	•	23960.	22821.	5008.	178.	4727.	42%	146.	3695.
1999	27836.	82701.	54865	875.	ċ	27870.	26731.	4738.	149.	. 144.	5976.	120.	3668.
2000	10547	94478.	63931.	846.	•	32388.	31249.	.98++	124.	4757.	3685.	98.	3634.
2001	33546.	107947.	74401.	P14.	9.	37607.	3645R.	4251.	103.	4765.	3418.	90.	3594.
2002	36865.	123352.	86487.	778.	•	43633.	42493.	4031.	65.	4770.	3174.	65.	3549.
2003	+0539+	140973.	100434.	73A.	÷	50586.	49447.	3824.	70.	4772.	2950.	52.	3500.
•	•	•	•	•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•	•	•	•	•
2012	97911.		372919.		•	186516.	185377.	2448.	3.	4663.	1581.	2.	2958.
TOTAL	967835	467835. 3626432. 2652598.	265 85 98	19888	28583.	1353034.	1324552.	123470-	24289.	125460.	109805.	22813.	95058.

ANALVSIS	ANALYSIS USING WEIGHTED COST OF CAPITAL (ST	CAPITAL	START	UP YEAR DOLLARS!	ANALYSTS	TARTUP YEAR DOLLARS! ANALYSIS USING RETURN ON EQUITY (STARTUP YEAR DOLLARS)	ISTARTUP YE	AR BOLLARS
ATANTAL AECOLO ACOLO ACCOLO AC	INTIMUM PRESENT VALUE = \$15938 IFVENUE UNIT PRESENT VALUE = \$ 7000 PRESENT VALUE = \$ 16640 PRESENT PRESENT PRESENT PRESENT PRESENTENTS = \$ 1700 PRESENTS = \$ 1700 PRESENTENTS = \$	110111111111111111111111111111111111111	3957 - THOUS 7.26 PER E 2.00 PER E	= \$159357. THQUSAND = \$ 7.26 PER MILLTON RTU = \$ 16641. THQUSAND = \$ 17.00 PER MILLION BTU	ATATACA ACCENCE ACCOURE	MINIMUM PARSENT VALUE = \$133907. THOUSAND ATVINUM PARSENT VALUE = \$6.11 PER MILL ARGUIRE- LEVELIZED COST = \$ 16.74. THOUSAND MENTS UNIT LEVELIZED COST = \$ 18.58 PER MILL SAVINGS/INVESTMENT RATIO = 4.67	11	# \$133907. THOUSAND # \$ 16.74. THOUSAND # \$ 16.74. THOUSAND # \$ 16.58 PER MILLION BTU
	DISCOUNTED PAYBACK FERIORS	R 100 =	 	44.4		DISCOUNTED PAYBACK PERIOD=		3.9 YEARS

^{*} PRESENT VALUE AT STARTUP USING BETGHTED COST OF CAPITAL = 15.90 PERCENT PER YEAR

** PRESENT VALUE AT STARTUP USING FETUAN ON FOULTY = 18.30 PERCENT FER YEAR

*** LEVELIZED COSTS ARE IN CONSTANT STARTUP POLLARS, TO CONVERT TO CURRENT DOLLARS MULTIPLY RY

**** LEVELIZED COSTS ARE IN CONSTANT STARTUP DOLLARS, TO CONVERT TO CURRENT DOLLARS MULTIPLY RY

1.559

column contains the present value of interest plus tax depreciation. The fourteenth column contains the present value of the after-tax equity cash flow.

The bottom of the report contains financial statistics calculated from the year-by-year amounts and totals from the upper part of the report. First, coal-use project minimum revenue requirements are presented. Present values, unit present values, levelized costs, and unit levelized costs are shown. These are followed by the investment ratio, the simple payback period, and the discounted payback period resulting from the cost and benefit analysis. Statistics calculated with both discount factors are included.

4.3.3 Reports 11 and 12 - Minimum Revenue Requirements

Tables 4-11 and 4-12 show Reports 11 and 12, which contain display year minimum revenue requirements built up from separate categories of cost. Report 11 shows the results of discounting with the weighted cost of capital. Report 12 shows the results of discounting with the return on equity. The reports show the elements that are included in the financing-related capital charge, and the labor, material, and purchased energy elements included in operating and maintenance costs. Column headings include costs, discount factors, present values, unit present values, levelizing factors, levelized costs, and unit levelized costs.

4.4 SUMMARIES AND COMPARISONS

This section describes the two summary reports generated by the coal-use economics methodology to compare the effect of differing venture structures on a project. One report or the other will be printed in a given run, depending on the commercial structure selected by the user.

4.4.1 Report 13 - Comparison of Navy Financed/Navy Operated and Third Party Financed/Navy Operated Ventures

Table 4-13 shows Report 13, which compares financial statistics for Navy financing with those for third party financing. The top half of the report treats Navy financing; the bottom half treats third party

Table 4-11

Report 11-

PRIVATE VENTURE MINIMUM REVENUE REGUIREMENTS DISCOUNTING WITH WEIGHTED COST OF CAPITAL

(COSTS IN MOVEMBER 1982 DOLLARS)

		COST (1000 1)	DISCOUNT	PRESENT VALUE (1000 8)	UNIT PRESENT VALUE	LEVELIZING FACTOR	COST	LEVELIZED COST .	•
٠	ANNUAL RETURN TO INVESTORS	2341.	6.1164	14316.	•69	1.000	2341.	2.67	
	ANNUAL CORPORATE INCOME TAXES	442.	6.1164	2701.	-12	1.0000	**5	• 50	
	ANNUAL PROPERTY TAXES. INSURANCE	287.	6.1164	1756.		1.000	287.	.33	
TOTAL	TOTAL CAPITAL CHARGES	3069.		18772.	90.	•	3069.	3.50	
	OPERATING (1987 - 2012)								
	LABOR	1703.	6.1164	10413.	e • •	1.0000	1703.	1.94	
	OPERATING + MAINTENANCE MATERIAL	1162.	6.1164	7109.	. 32	1.000	1162.	1.33	
	ELECTRICITY	256.	14.6643	3759.	.17	2.3975	615.		
	6.18	•	27.6883	544.	. 02	9655.4	89.	•10	
	STEAT	17.	14.6643	252.	. 01	2.3975	+1.	50 •	
	011	23.	20.1042	462.	• 62	3.2669	76.	60.	
	COAL	2762.	12.5810	34745	1.59	2.0569	5681.	9+-9	
TOTAL	TOTAL OPERATING			57284.	2.62		9366.	10.69	
TOTAL	TOTAL LIFE CYCLE COST			76056.	4.60		12435.	14.20	

UNIT PRESENT VALUE PASED ON 21988. BILLION RTU HEAT TRANSFERRED OVER 25.8 YEARS OF LIFE

^{**} LEVELIZED COST IN CONSTANT DISPLAY DOLLARS. TO CONVERT TO CURRENT DOLLARS MULTIPLY BY

Table 4-12

Report 12-

PRIVATE VENTURE MINIMUM REVENUE REQUIREMENTS DISCOUNTING WITH RETURN ON EDUITY

(COSTS IN NOVEMBER 1962 DOLLARS)

UNIT LEVELIZED COST (\$/MILLION BTU)	2.11		60.	e n•	E + 49	!	•••		29.	•		•	6.24	70*	13.86
LEVELIZED COST ++ (1909 8)	1847.	266.	341.	297.	3052.		1765.	1162.	596.	62.	39.	7.	5466.	9109.	12161.
LEVELIZING FACTOR	1.0000	1.0000	1 -0 000	1.0000		•	1.000	1.000	2.2877	4.2654	2.2877	5.0837	1.9791		
PRESENT VALUE		•12	66.	.00	.67		.37	• 26	. 13	• 62		• 02	1.20	2.80	2.67
PRESENT VALUE (1000 S)	8692.	2723.	1643.	1431.	14689.		9194.	5595.	2822.	345.	189.	341.	26307.	43844.	58532.
DISCOUNT FACTOR	4.8132	4.A132	4.A132	4.8132			4.8132	4.8132	11.0111	20.2416	11.0111	14.8424	9.5257		
E00177 COST (1000 \$)	1847.	566.	341.	297.	3052.		1703.	1162.	256.	19.	17.	23.	2762.		
CAPITAL	ANNUAL RETURN TO EQUITY HOLDERS	ANNUAL DEBT SFRVICE	AMNUAL CORPORATE INCOME TAKES	ANNUAL PROPERTY TAXES. INSURANCE	TOTAL CAPITAL CHARGES	OPERATING (1927 - 2012)	LABOR	OPERATING + MAINTENANCE MATERIAL	ELECTAICITY	6AS	STEAN	OIL	COAL	TOTAL OPERATING	TOTAL LIFE CYÇLE COST

UNIT PRESENT VALUF BASED ON 21900. BILLION RTU HEAT TRANSFERYED OVER 25.0 YEARS OF LIFE

^{2.014} ••• CONSTANT DOLLAR UNIT LEVELIZED COST BASEN ON A76.00 BILLION BTU HEAT TRANSFERRED PER YEAR LEVELIZED COST IN CONSTANT DISPLAY DOLLARS. TO CONVERT TO CURRENT DOLLARS PULTIPLY BY

-13
le 4
Tab

Report 13-

SUBBRANT

MANY FINANCED/NAVY OPERATED VENTURE VS. THIRD PARTY FINANCED/NAVY OPERATED VENTURE

PRESENT VALUE REFERENCED TO STARTUP YEAR (11/1987)
PRESENT VALUE REFERENCED TO DISPLAY YEAR (11/1982)

	8 70150 THOUSAND	•	S 13.54 PER HILLION	D 4.3 YEARS
MAYY FINANCED/NAVY OPERATED YENTURE:	PRESENT VALUE	UNIT PRESENT VALUE	UNIT LEVELIZED COST	SAVINGS/INVESTMENT RATIO DISCOUNTED PAYBACK PERIOD

151145. THOUSAND 6.98 PER MILLION BTU 15876. THOUSAND 18.12 PER MILLION STU

VFNTURE:
OPERA TED
F INANCED/NAVY
PARTY
THIRD

	SISGE24. THOUSAND S 6.86 PER MILLION BTU S 15616. THOUSAND S 18.85 PER MILLION BTU YEARS	6354. THOUSAND PER YEAR 15 years
	s 4986A. THOUSAND S 2.19 PER WILLION BTU S 11919. THOUSAND S 13.49 PER WILLION BTU 6-18	\$ 6354. 15
MAYY OPERATOR	PRESENT VALUE UNIT PRESENT VALUE LEVELIZED COST UNIT LEVELIZED COST SAVINGS/INVESTMENT RATIO DISCOUNTED PATBACK PERIOD	PAIVATE INVESTOR LEVELIZEO REVENUE (LEASE) LEASE LIFE

financing. The statistics, already displayed in previous reports, are redisplayed in this summary in both display and startup year dollars. All statistics are calculated with Navy economics. The third-party lease cost and lease life are shown.

4.4.2 Report 14 - Comparison of Navy Financed/Navy Operated and Third Party Financed/Third Party Operated (All Private) Ventures

Table 4-14 shows Report 14, which compares financial statistics for Navy financing with those for private financing. The top half of the report treats the Navy project; the bottom half treats the private project. The statistics, already displayed in previous reports, are redisplayed in this summary in both display and startup year dollars. Statistics for the all-Navy venture are calculated with Navy economics. Statistics for the all-private venture are calculated with commercial economics, using both the weighted cost of capital and the return on equity as discount factors.

Table 4-14

CHANGE TO SEE THE SEE SEE SEE

STATES STATES STATES

Report 14

SUMMARY:

W
2
5
Œ
•
-4
3
•
•
0
₩
=
2
ī
0
_
5
œ.
•
•
۵
æ
=
Ξ
Ξ
ã
ũ
$\mathbf{\tilde{c}}$
3
3
~
_
=
•
•
•
_
ž
-
Z.
-
•
€0
>
z
3
<u></u>
2
3
_
E
Ŀ
5
7
L
Ť
•
>
>
≤
=
2
<u>.</u>
ü
=
Ž
Ž
FINANCEN/WAYY OPERATEN VENTURE VS. THIRD PARTY FINANCED/THIRD PARTY OPERATED (ALL PRIVATE

STATE PRIVALES VENIONE	PRESENT VALUE REFERENCED TO STARTUP YEAR (11/1967)
RATEN VENTURE VS. TRIRO PARTY FIRANCED/THIRO PARTY OPERATED FALL FRIVALES VENTURE.	PRESENT VALUE REFERENCED TO DISPLAY VEAR (11/1982)
S. THIRD	
VENTURE V	
OPERATER	
NAVY FINANCEN/NAVY OPERAT	

NAVY FINANCED/NAVY OPERATED VENTURE:

\$ 6.99 PER WILLION STU \$ 15070. THOUSAND \$ 18.12 PER WILLION BTU	VEARS
S 3.20 PER MILLION BTU S 11 PS9. THOUSAND S 15.54 PER 41LLFON BTU) W
PRESENT VALUE UNIT PRESENT VALUE LEVELIZED COST UNIT LEVELIZED COST	SAVINGS/INVESTMENT NATIO DISCOUNTED PAYBACK PERIOD

THIRD PARTY FIRANCED/THIRD PARTY OPERATED (ALL PRIVATE) VENTURE:

AFTER-TAX NET CASM FLOW ANALYSIS DISCOUNTING WITH WEIGHTED COST OF CAPITAL

\$159657. THOUSAND \$ 7.26 PER MILLION BTU \$ 16641. THOUSAND \$ 19.80 PER MILLION BTU YEARS	
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
S 76056. THOUSAND S 2.47 PER RILLION BTU S 12435. THOUSAND S 14.20 PER MILLION BTU 4.19	
8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	
IRIMUM PEVENUE REQUIREMENT AL S) T T T T T T T T T T T T T T T T T T T	ø
EVENUE	IN FLOW ANALYSI IURN ON EQUITY
PRESENT VALUE OF MINIMUM PUNIT PRESENT VALUE LEVELIZED COST (REAL \$) UNIT LEVELIZED COST SAVINGS/INVESTMENT RATIO SIMPLE PAYBACK PERIOE DISCOUNTER PAYBACK PERIOD	AFTER-TAX EQUITY CASH FLOW ANALYSIS DISCOUNTING WITH RETURN ON EQUITY

153997. THOUSAND 6-11 PER HILLTON BTU 16274. THOUSAND 18-58 PER MILLTON BTU	
***** ********************************	
VEA	
THOUSAND PER WILLION BTU THOUSAND PER MILLION BTU 4-67 2-8 3-9	
50 60 60 60 60 60 60 60 60 60 60 60 60 60	
25.00	
PEVENUE REQUIREMENT	
PRESENT VALUE OF PINIMUM FEVENUE REQUIREMENT \$ 58552. THOUSAND UNIT PRESENT VALUE LEVELIZED COST (PFAL \$) LEVELIZED COST (PFAL \$) LEVELIZED COST (PFAL \$) LEVELIZED COST UNIT LEVELIZED COST SAVINGS/INVESTMENT RATIO SINCE PER MILLION BTU \$ 15.48 PER MILLION BTU \$ 15.49 PER SINCE 2.8 PEARS SOURCE PER SINCE SOURCE PER SINCE	
•	

Section 5

MOMPROPIT ENTITY PROJECTS

The coal-use economics methodology can be applied in either of two ways to projects undertaken by nonprofit entities such as universities and state and local governments:

- For nonprofit financed/nonprofit operated ventures, substitute nonprofit parameters for commercial data, as follows:
 - Set the income tax rate equal to zero.
 - Set the property tax and insurance rate to reflect insurance costs only.
 - Set capital structure data to reflect the source of funds, e.g., 100 percent debt at 9 percent/year, or 50 percent equity portfolio at 12 percent/year when inflation is 6 percent/year.
 - Input no depreciation information. Default values will be supplied by the program and ignored by the calculations.

This method will give results for all-Navy and all-nonprofit venture structures side by side. The nonprofit venture will be labeled "private venture."

For profit-making, third party financed/nonprofit operated ventures, choose input data as follows:

- Insert the nonprofit constant dollar discount rate in place of the Navy discount rate.
- Insert capital structure and depreciation data appropriate to the profit-making third party, and indicate the third party lease life.

This method will give results for all nonprofit and third party venture structures side by side, with nonprofit statistics generated instead of Navy statistics. The reports will be labeled "Navy." An appropriate annual capital charge for property taxes and insurance must be calculated and added by hand to the levelized costs. To find the Navy equivalents to the two nonprofit reports generated by this method, the calculation must be rerun using the Navy constant dollar discount rate (the default is 10 percent).

REFERENCES

(project block and and project by the design for the design factor of the design and a second and a second and the second and a second

- 1-1 Economic Analysis Handbook, P-442, Naval Facilities Engineering Command, 1975.
- 1-2 Slaminski, J. M., "Economic Analysis and Priority Rating Formulation for Navy Shore Facilities Energy R&D Projects," Civil Engineering Laboratory, Naval Construction Battalion Center, Port Hueneme, California, November 1977.
- 1-3 Instruction for Preparation of Economic Analyses, LANTHAVFACENGCOM, 407:ARM, March 19, 1980.
- 1-4 Ward, Carter J., "Simplified Economic Analysis for Navy Shore Facilities Energy R&D Products," Civil Engineering Laboratory, Maval Construction Battalion Center, Port Hueneme, California, December 11, 1979.
- 1-5 "Energy Escalation Rates for Short Term Costing and Life Cycle Costing," Draft, August 23, 1976.
- 1-6 Coal Conversion Cost Computer Program, Peter F. Loftus Corporation, Pittsburgh, Pennsylvania, Draft NCEL Contract Report, Contract M62474-81-C9409, September 1982.
- 3-1 Paul H. Jeynes, <u>Profitability and Economic Choice</u>, Ames, Iowa, the Iowa State University Press, 1968.
- 3-2 <u>Technical Assessment Guide</u>, Special Report, EPRI PS-1201-SR, Electric Power Research Institute, Palo Alto, California, July 1979.
- 4-1 COALR Coal Conversion Cost Reformulation Program: User Manual,
 Bechtel Group, Inc., San Francisco, California, Draft NCEL Contract
 Report, Contract M62474-82-C-8290, September 1983.

COMPUTER PROGRAM USER MANUAL

COALR COAL CONVERSION COST REFORMULATION PROGRAM

CONTENTS

Section				Page
1	PROG	RAM CAPAI	BILITY	1-1
	1.1	Program	Description	1-1
	1.2	Program	Features	1-2
		1.2.1	Navy and Commercial Economics	1-2
		1.2.2	Financial Statistics	1-3
		1.2.3	Venture Structures	1-3
		1.2.4	Startup Year Versus Display Year Dollars	1-4
		1.2.5	Comparisons with Use of Oil or Gas	1-4
	1.3	Program	Limitations	1-4
2	COMP	JTATIONAL	. PROCEDURES	2-1
	2.1	Data and	Methodology Sources	2-1
	2.2	Summa ry	of Computational Procedures	2-1
	2.3	Input Da	ata Reformulation	2-2
		2.3.1	Reference Times	2-2
		2.3.2	Adjustment of Cost Estimate Reference Times	2-3
	2.4	Treatmen	nt of Discounting and Inflation	2-3
		2.4.1	Present Values	2-3
		2.4.2	Levelized Costs	2-4
		2.4.3	Effects of General Inflation	2-5
		2.4.4	Differential Inflation of Purchased Energy	2-6
	2.5	Project	Life Cycle Costs	2-7
	2 6	Deinata	Castan Income Toyon	2-11

Section			Page
	2.7	Analyses of Costs and Benefits	2-13
		2.7.1 Navy Comparison Statistics	2-13
		2.7.2 Commercial Comparison Statistics	2-14
3	INPU'	T DESCRIPTION	3-1
	3.1	Problem-Oriented Unformatted Input	3-1
	3.2	Input Deck Organization	3-4
	3.3	Title and Descriptive Information	3-5
	3.4	Plant Data	3-5
	3.5	Coal Data	3-6
	3.6	Utility Data	3-6
	3.7	Economic Data	3-7
	3.8	Reformulation Data	3-9
	3.9	Comparison Data	3-11
	3.10	Commercial Data	3-11
4	PROG	RAM OUTPUT	4-1
	4.1	Input Data Echo	4-1
	4.2	Financial Analysis Reports	4-2
5	PROG	FRAM EXECUTION	5-1
	5.1	Batch Mode Execution	5-1
		5.1.1 Indentification Cards	5-2
		5.1.2 Procedure Cards	5-2
		5.1.3 End-of-Record Card	5-2
		5.1.4 Input Data Cards	5-2
		5.1.5 End-of-Information Card	5-2
	5.2	Demand Mode Execution	5-4
		5 2 1 Greation of Joh Control File	5-4

Section			Page
		5.2.2 Submission of Job Control File	5-4
	5.3	Procedure Statements	5-6
		5.3.1 Run with User Input Cases	5-6
		5.3.2 Run with EXAMPLR Sample Input Case	5-6
		5.3.3 Generation of Compilation Listing	5-7
	5.4	Resources Required to Execute Procedures	5-7
6	ERRO	R PROCESSING	6-1
	6.1	Input Editing Error Messages	6-1
	6.2	Calculation Error Messages	6-1
7	TEST	PROCEDURES	7-1
8	CODE	DESCRIPTION	8-1
	8.1	Hierarchy Diagram	8-1
	8.2	Subroutine Descriptions	8-3
		8.2.1 The Message Routine	8-3
		8.2.2 Case Run Input Routines	8-3
		8.2.3 The Cost Reformulation Routine	8-3
		8.2.4 Financial Analysis Routines	8-3
	8.3	Logic Flow Diagrams	8-4
	8.4	Common Blocks	8-4
	8.5	Files	8-4
9	USE	OF COALR TO REPLICATE COMMERCIAL FINANCIAL ANALYSES	9-1
	REFE	RENCES	R-1
Appendi	<u> </u>		
A	COAL	R Outputs Generated by Run with Input File EXAMPLR	A-1
В	Proc	edure to Converge to a Desired Output Quantity by	p_1

TABLES

Table		Page
2-1	Typical Current Dollar and Constant Dollar Discount Rates for 6 Percent Per Year General Inflation	2-6
2-2	Typical Differential Inflation Rates for Energy Produced by Navy Bases	2-7
2-3	Methods for Calculating Capital Depreciation for Tax Purposes	2-12
5-1	Typical Batch Mode Identification Cards	5-3
5-2	Typical Demand Mode Job Control File	5-5
5-3	Computer Resources Required to Execute COALR Procedures	5-7
6-1	Input Error Messages	6-2
7-1	Major Options Demonstrated by Run EXAMPLR	7-2
7-2	Calculations Verified by Hand Check for Major Program Options	7-3
7-3	Minor Options Verified by Spot Check	7-4
8-1	COALR Common Block Incidence Table	8-13
8-2	Names and Functions of COALR Files on Tape COLCONV	8-14
A-1	Case 1 - Third Party Financed/Navy Operated Venture, ACRS Depreciation, Comparison with Oil Firing	A-2
A-2.	Case 2 - Third Party Financed/Third Party Operated (All Private) Venture, ACRS Depreciation, Comparison with Oil Firing	A -3
A-3	Case 3 - Third Party Financed/Navy Operated Venture, SOYD Depreciation, Comparison with Burning Oil	A-4
A-4	Case 4 - Third Party Financed/Navy Operated Venture, ACRS Depreciation, Comparison with Burning Gas	A-5
B-1	Direction of Change in Calculated Quantities Produced by Increases in Input Variables	B-6
B-2	Scalar Procedure Sample Problem	B-9
B-3	Vector Procedure Sample Problem	B-11

ILLUSTRATIONS

		- .
Figure		Page
1-1	Operation of the Program COALR	1-1
1-2	Reports Produced by COALR	1-5
1-3	Summary Logic Flow Diagram for Financial Calculations	1-6
2-1	Typical Cost Cash Flow Diagram of Coal Conversion Project	ts 2-9
3-1	Sample Input Data for COALR	3-2
8-1	COALR Hierarchy Diagram	8-2
8-2	Logic Flow Diagram for Subroutine NECON 1, Calculation of Navy Present Values and Levelized Costs (Reports 1, 2 4 and 5)	, 8-6
8-3	Logic Flow Diagram for Subroutine NECON 2, Calculation of Navy Cost and Benefit Analyses (Report 3)	8-7
8-4	Logic Flow Diagram for Subroutine CECON 2, Calculation of Investor Cash Flows During Construction Period (Reports 6 and 9)	8-8
8-5	Logic Flow Diagram for Subroutine CECON 3, Calculation of Third Party Investor Cash Flows During Operating Perio (Report 7)	od 8-9
8-6	Logic Flow Diagram for Subroutine CECON 5, Calculation of Navy Cash Flows During Operating Period (Report 8)	8-10
8-7	Logic Flow Diagram for Subroutine CECON 4, Calculation of Private Venture Cash Flows During Operating Period (Report 10)	8-11
8-8	Logic Flow Diagram for Subroutine CECON 1, Calculation of Private Venture Minimum Revenue Requirements (Reports 11 and 12)	8-12
B-1	Method of Successive Trials for a Scalar Input Variable	B-3
B-2	Method of Successive Trials for a 2-Component Vector of Input Variables	B-5
B-3	Form for Preparing Successive Trials Computation of Independent Variable x to Give Target Dependent Variable	y B-8

Section 1

PROGRAM CAPABILITY

1.1 PROGRAM DESCRIPTION

Series and the series are the series and the series and the series are the series are the series and the series are the series

COALR - Coal Conversion Cost Reformulation Program - is a computer program prepared for the Naval Civil Engineering Laboratory (NCEL), Port Hueneme, California, by Bechtel Group, Inc., as part of the work of Phase I of "Engineering Services for Coal Conversion Guidance," Navy Contract N62474-82-C-8290. COALR incorporates the coal-use economics methodology prepared in the Phase I work. COALR was constructed by adapting an existing NCEL computer program.

COALR accepts as program input coal-use project costs estimated in the dollars of some reference year. The program then reformulates the project costs to the dollars of a user-chosen display year. Finally, the program calculates life cycle costs and financial statistics for the coal-use project. The operation of COALR is summarized in Figure 1-1.

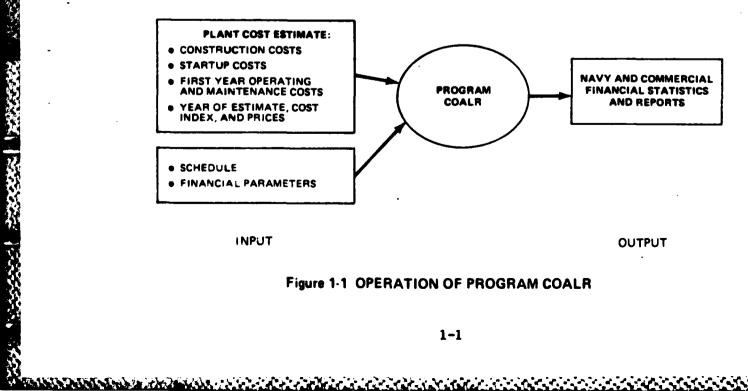


Figure 1-1 OPERATION OF PROGRAM COALR

1.2 PROGRAM FEATURES

COALR has been constructed as a versatile tool permitting the results of several different economic analyses to be viewed side by side. COALR has the following capabilities:

- Economic analyses using both Navy and commercial financial assumptions
- Presentation of seven financial statistics
- e Treatment of three venture structures
- e Reporting in both startup year and display year dollars
- e Comparisons with use of fuel oil or natural gas

1.2.1 Navy and Commercial Economics

COALR includes both Navy and commercial economic analyses. Similarities between the two analyses are:

- Both are based upon computation of project present values using discount rates chosen by the user.
- Both aim to produce capital charge rates typical of those encountered in the private sector.

The two analyses differ principally in the way they take into account corporate income taxes paid by the private sector:

- The Navy economic analysis achieves the reality of private sector capital charges by using a discount rate that is an average of corporate gross profit rates since World War II. Use of this discount rate produces a single capital charge term that includes both return to investors and an allowance for corporate taxes. Since the Navy pays no income taxes, they are not calculated.
- The commercial economic analysis uses a discount rate that contains only return to investors, and use of this discount rate produces a capital charge term that contains only return to investors. To obtain a total capital charge, a term is added for the capital charge of corporate income taxes, calculated under present or previous tax laws for depreciation and investment credits.

1.2.2 Financial Statistics

COALR operates on project costs (capital and operating costs) to produce seven commonly occurring financial statistics for comparing energy project life cycle costs. These statistics are:

- Present value
- Unit present value
- Levelized cost
- Unit levelized cost
- Savings/investment ratio
- Discounted payback period
- Simple payback period

All seven statistics are calculated using commercial economics. The first six are also calculated using Navy economics. For both Navy and commercial economics the levelized costs and unit levelized are presented in constant (real) dollars.

1.2.3 Venture Structures

COALR treats the following three venture structures:

- Structure 1 Navy financing/Navy operation
- Structure 2 Third party financing/Navy operation
- Structure 3 Third party financing/third party operation (all private)

Statistics for Structure 1 are calculated with Navy economics only. Statistics for Structure 2 are calculated using Navy economics, except for lease payments, which are determined by commercial economics. Statistics for Structure 3 are calculated entirely with commercial economics. Structure 3 can also be used for nonprofit organization projects by ignoring taxes.

1.2.4 Startup Year Versus Display Year Dollars

The financial statistics are presented in both plant startup year dollars and dollars of an arbitrary year selected by the user, called the display year. User purchased energy price input data is entered in display year dollars.

1.2.5 Comparisons with Use of Oil or Gas

COALR includes analyses of both the costs and benefits of displacing fuel oil or natural gas by a new coal-use project. The comparison analyses result in calculation of three of the financial statistics: the savings/investment ratio, the discounted payback period, and the simple payback period.

Figure 1-2 names the 14 possible reports generated by the Phase I program. The reports generated in a given run depend on the user-selected commercial venture option (third party financed or all private).

Figure 1-3 is a logic flow diagram which summarizes the financial calculations performed by COALR. First, subroutine CALCR reformulates the plant cost estimate to display year dollars. Then subroutine ECONR calls the financial subroutines which produce the output reports.

1.3 PROGRAM LIMITATIONS

COALR has the following limitations:

- The general inflation rate and energy commodity differential inflation rates are assumed constant during the coal-use project life cycle of construction and operation.
- The Navy discount rate and the commercial rates for interest on debt and return on equity are assumed constant during the coal-use project life cycle of construction and operation.
- The program compares the life cycle costs of the coal use project with the life cycle costs of a base case burning oil or gas in existing boilers. The base case does not include any capital costs to install new oilor gas-fired boilers.

NAVY FINANCED/NAVY OPERATED VENTURE

REPORT 1

NAVY PRESENT VALUES IN DISPLAY YEAR DOLLARS

REPORT 2

NAVY LEVELIZED COSTS IN DISPLAY YEAR DOLLARS

REPORT 3

NAVY COST AND BENEFIT ANALYSIS

REPORT 4

NAVY PRESENT VALUES IN STARTUP YEAR DOLLARS

REPORT 5

NAVY LEVELIZED COSTS IN STARTUP YEAR DOLLARS

THIRD PARTY FINANCED/NAVY OPERATED VENTURE

REPORT 6

INVESTOR CASH FLOWS DURING CONSTRUCTION PERIOD

REPORT 7

INVESTOR CASH FLOWS DURING OPERATING PERIOD

REPORT 8

NAVY CASH FLOWS DURING OPERATING PERIOD

THIRD PARTY FINANCED/THIRD PARTY OPERATED (ALL PRIVATE) VENTURE

REPORT 9

PRIVATE VENTURE
CASH FLOWS
DURING CONSTRUCTION
PERIOD

REPORT 10

PRIVATE VENTURE CASH FLOWS DURING OPERATING PERIOD

REPORT 11

PRIVATE VENTURE
MINIMUM REVENUE
REQUIREMENTS
DISCOUNTING WITH
WEIGHTED COST OF
CAPITAL

REPORT 12

PRIVATE VENTURE MINIMUM REVENUE REQUIREMENTS DISCOUNTING WITH RETURN ON EQUITY

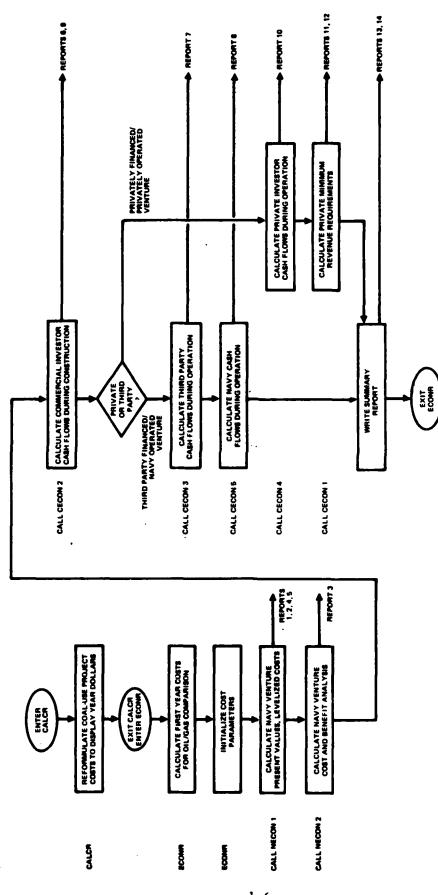
SUMMARIES

REPORT 13
NAVY FINANCED/
NAVY OPERATED
VS
THIRD PARTY
FINANCED/NAVY
OPERATED

REPORT 14

NAVY FINANCED/ NAVY OPERATED VS THIRD PARTY FINANCED/ THIRD PARTY OPERATED

Figure 1-2 REPORTS PRODUCED BY COALR



PARTY DESCRIPTION OF THE SECRETARY S

A. S. S. S. S.

Figure 1-3 SUMMARY LOGIC FLOW DIAGRAM FOR FINANCIAL CALCULATIONS

Section 2

COMPUTATIONAL PROCEDURES

This section presents data and methodology sources for COALR and outlines the calculations used to produce the fourteen reports illustrated in Figure 1-2.

2.1 DATA AND METHODOLOGY SOURCES

The coal-use economics methodology used in COALR is described in Reference 2-1. Navy economic analysis methods are described in References 2-2 through 2-5. Commercial economic analysis methods, including formulas for compound interest factors, are described in Reference 2-6. Annual operating and maintenance costs for oil- and gas-fired comparison cases are taken from Reference 2-7.

2.2 SUMMARY OF COMPUTATIONAL PROCEDURES

The computational procedures of COALR are described below in a way that highlights similarities between Navy and commercial financial analyses. The following subjects are discussed:

- e Input data reformulation, dealing with adjustment of the cost estimate reference time
- Treatment of discounting and inflation, dealing with present values, levelized costs, general inflation, and differential escalation
- Life cycle cost analyses, dealing with closed form annuity calculations, producing the following coal-use project financial statistics:
 - Total present value
 - Unit present value
 - Levelized costs
 - Unit levelized costs

- Private sector income taxes
- Analyses of costs and benefits, dealing with year-by-year calculations to produce the following financial statistics:
 - Savings/investment ratio
 - Discounted payback period
 - Simple payback period

2.3 INPUT DATA REFORMULATION

2.3.1 Reference Times

COALR works with the following three reference times:

- Base year the year of the plant cost estimate
- Display year a year chosen by the user for presentation of financial statistics
- Startup year the year of plant startup

The user must specify the base year by providing the following cost parameters: plant cost index, hourly labor rate for operation and maintenance, and prices for purchased coal, electricity, fuel oil, natural gas, and auxiliary steam. These cost parameters are input by the user along with the cost estimate for plant installation and operation.

The display year and the startup year are selected by the user and are used as reference times for present value calculations in the financial analyses. To specify the selected display year, the user must input the following cost parameters: plant cost index, hourly labor rate for operating and maintenance, and prices for purchased coal, electricity, fuel oil, natural gas, and auxiliary steam.

The user is free to select a preferred plant cost index system, but once selected, the same system must be used in a given analysis.

2.3.2 Adjustment of Cost Estimate Reference Times

The first step performed by COALR is the conversion of the input cost estimate from base year dollars to display year dollars. This conversion (or reformulation) is performed in the following way:

- A ratio is formed for each cost parameter between the display year value (in the numerator) and the base year value (in the denominator).
- Construction, startup, and first year operating and maintenance material costs in the cost estimate are multiplied by the ratio of the plant cost indices for the display year (in the numerator) and the base year (in the denominator).
- Similarly, the first year purchased energy costs in the cost estimate are multiplied by the corresponding ratio of energy prices.

2.4 TREATMENT OF DISCOUNTING AND INFLATION

Once the cost estimate is available in display year dollars, COALR then distributes the capital and first year costs to their year of occurrence in plant construction and operation, and then discounts the costs to their present values at a "Year O" reference time (the display year or startup year, depending on the section of the code). In performing the calculations, COALR makes frequent conversions between startup year and display year costs. In all of the calculations, user specified rates of inflation and differential inflation are taken into account.

2.4.1 Present Values

COALR includes calculation of present values with a Navy discount rate and two different private sector discount rates, all of which can be set by user input:

- Navy discount rate a social opportunity cost which includes the equivalent of the return required by investors and an allowance for the capital charge associated with corporate income taxes.
- Return on equity the return which private sector equity holders require on the equity portion of a private sector investment.

 Weighted cost of capital - the weighted average of private sector interest on debt and after-tax return required by equity holders. The weighted cost of capital is calculated from inputs of debt fraction, interest, and return on equity.

The present value of a construction period cash flow is the product of the amount of the cash flow and the discount factor for the year in which the cash flow occurs. According to the type of structure, the following conventions are used in COALR for timing a cash flow for a given year:

- Navy convention the cash flow is distributed uniformly over the year
- Commercial convention the cash flow is assumed to occur at the end of the year

The discount factor formulas for cash flow used by COALR are different in the two timing conventions.

COALR includes closed form calculations of the present value of a stream of equal cash flows recurring annually for N years, known as annuity. The total present value of an annuity is calculated as the product of the first year cash flow and a "cumulative uniform series" discount factor.

2.4.2 Levelized Costs

The present value statistic is also converted by COALR into a financially equivalent annuity known as levelized cost. Unit levelized costs (in dollars per million Btu of energy) are convenient because they can be validly compared with current prices for purchased energy in a noninflationary period.

The levelized cost is the best statistic for comparing Navy and commercial economic analyses, because in levelized costs the differences due to differing discount rates are minimized.

2.4.3 Effects of General Inflation

In COALR, a user-specified general inflation rate is assumed to remain constant throughout the life of a project to install and operate a plant.

To separate cost effects resulting from inflation from those which are independent of inflation, COALR distinguishes between costs in "current dollars" and those in "constant dollars":

- Current (inflating) dollar costs reflect changes which are to be paid at the time the costs are incurred. During inflationary periods, the prices of most commodities rise over time, so annually recurring costs will rise at or near the general inflation rate when expressed in current dollars.
- Description of the general prices and wage levels of a specific "Year 0" remained constant over time, as if general inflation were "turned off" at Year 0.

COALR relates the discount rate in current dollars to the discount rate in constant dollars according to the relation:

$$(1 + r_{cur}) = (1 + r_{const}) (1 + g)$$

where:

r_{cur} = current dollar discount rate

r_{const} = constant dollar discount rate

g = rate of general inflation

Table 2-1 compares typical current dollar and constant dollar discount rates for the three types of discount rate when there is a 6 percent per year general inflation.

Present values at a Year 0 are calculated by either of the following methods when inflation is present:

- Costs in current dollars are discounted at the current dollar discount rate.
- Costs in constant dollars referenced to Year 0 are discounted at the constant dollar discount rate.

Table 2-1

TYPICAL CURRENT DOLLAR AND CONSTANT DOLLAR DISCOUNT RATES FOR 6 PERCENT PER YEAR GENERAL INFLATION

Type of Discount Rate	Current Dollar Discount Rate, percent/year	Constant Dollar Discount Rate, percent/year
Return on Equity	18.00	11.1
Weighted Cost of Capital	15.90 ⁽¹⁾	9.3
Navy	16.60	10.0

(1) The 15.90 percent per year value represents a project capital structure containing 70 percent equity paying 18 percent per year and 30 percent debt paying 11 percent per year.

The present values calculated by the two methods are identical and COALR uses the two methods interchangeably.

Consistent with Navy convention, levelized costs are calculated in constant dollars in COALR.

Startup year present values are converted to display year present values in COALR by discounting at the current dollar discount rate. Startup year levelized costs are converted to display year levelized costs by de-escalating at the general inflation rate.

2.4.4 Differential Inflation of Purchased Energy

To accommodate purchased energy prices which may increase faster than general inflation, COALR allows specification of a separate differential inflation rate (DIR) for each purchased energy commodity. The DIR is approximately the amount by which the commodity inflation rate exceeds the general inflation rate, and it is defined exactly by the relation:

$$DIR = \frac{1+e}{1+g} - 1$$

Here,

- e * energy commodity inflation rate, decimal fraction per year
- g = general inflation rate, decimal fraction per year

Typical DIR values for various purchased energy commodities are given in Table 2-2. COALR combines the DIR with the constant dollar discount rate "r" to obtain an effective discount rate "x" through the formula,

$$x = \frac{1+r}{1+DIR} - 1$$

This formula, the basis for tabulated discount factors in Reference 2-2, is used in both Navy and commercial life cycle cost analyses.

Table 2-2

TYPICAL DIFFERENTIAL INFLATION RATES
FOR ENERGY PURCHASED BY NAVY BASES

Type of Purchased Energy	Differential Inflation Rate (DIR)(1), percent/year
Coal	5
Electricity	6
Steam	6
Fuel Oil	8
Natural Gas	10

(1) The DIR values shown are those recommended in Reference 1-5.

2.5 PROJECT LIFE CYCLE COSTS

COALR calculates the following four economic statistics from the costs of plant construction and operation:

- Present value
- Unit present value
- Levelized cost
- Unit levelized cost

These calculations consider only costs, and do not consider cash flows of income for sale of the products of the plant. The resulting financial statistics are called life cycle costs. In the private sector analysis they measure the minimum revenues the plant must earn through sale of products to pay all expenses and taxes and to pay investors the minimum return that they require. The Navy analysis leads to comparable life cycle costs.

Figure 2-1 is the cost cash flow diagram for a typical coal-use project for calculations with Year 0 as the startup year.

Construction period costs include the year-by-year construction costs and the startup (or owner's) costs incurred the last construction year. In commercial economic analyses, construction period costs are reduced by an investment tax credit. The present value of all construction period cash flows in startup year dollars is the total capital investment for the project.

Operating period costs, treated separately by COALR, include the following cost items:

- Operating and maintenance labor
- Operating and maintenance materials
- Coal
- Auxiliary electricity
- Auxiliary oil
- Auxiliary natural gas
- Auxiliary steam

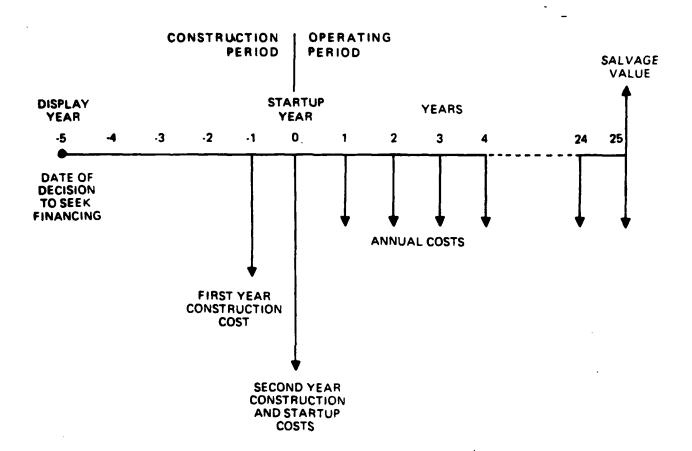


Figure 2-1 TYPICAL COST CASH FLOW DIAGRAM OF COAL CONVERSION PROJECTS

The present values of the operating period costs are calculated and summed to yield a total present value for operating and maintenance.

COALR assumes that the plant will operate at the same load factor each year of its specified economic life.

If there is salvage value at the end of the operating period, its present value is a negative entry in computing the total present value of project costs.

Levelized life cycle costs are calculated from the construction period present values and the operating period present values. The resulting costs associated with the investment appear as annual capital charges added to the levelized annual operating and maintenance costs.

The capital charge has similar magnitude in Navy and commercial economics, but it is calculated differently in the two analyses:

- In Mavy economics, the capital charge is simply the levelized cost of the present value of the investment.
- In commercial economics, the capital charge is the sum of the following operating period levelized costs:
 - Return to equity holder
 - Debt service
 - Corporate income taxes
 - Property taxes and insurance

COALR includes property taxes and insurance for privately operated ventures but not for Navy operated ventures, since local taxes are not levied on government land, and insurance is not usually included in Navy economic analyses. The annual property tax and insurance are typically 2 percent of the total capital requirement.

2.6 PRIVATE SECTOR INCOME TAXES

When calculating commercial minimum revenue requirements, COALR calculates federal and state corporate income taxes as a function of the minimum revenue requirement for return to investors (the "after-tax cash flow") by the following tax formula:

$$T = \frac{t}{1-t} \quad (A - D - I)$$

where

T = annual corporte income tax

t = the tax rate, typically 50 percent

A = annual after-tax cash flow

D = annual capital depreciation for tax purposes

I = annual interest paid on debt

Since capital depreciation and interest payments vary from year to year, COALR performs a year-by-year calculation to determine the corresponding tax and its present value. The total life cycle present value of income tax is obtained by summation.

The capital depreciation for tax purposes is calculated in COALR by one of the following two methods, specified by the user (and summarized in Table 2-3):

- Sum-of-the-Years-Digits (SOYD), in use for several decades
- Accelerated Cost Recovery System (ACRS), introduced recently

COALR calculates interest on debt on a year-by-year basis assuming constant annual payments for debt service (the sum of interest and principal).

METHODS FOR CALCULATING CAPITAL DEPRECIATION FOR TAX PURPOSES Table 2-3

11.0	Hethod 1 - Sum of the Yearn Digits	Hethod 2 - Accelerated Capital Recovery System
Motinition of Tan Depreciable Capital Motation THC - Tan Depreciable Capital, dollars CC - Construction Cost, dollars IDC - Interest Paring Construction, dollars SC - Startup (Paner's) Costs, dollars ITC - Isosetment Tan Credit, dollars (1)	76 + 10C + 10C = 0.4 SC	7DC - CC + IDC + 0.4 SC - 0.5 ITC
Annual Depreciable Deduction		
Notation	ADD = THC : 19F	ADO = TDC • DF
ADD - Annual Depreciation Deduction, dollars	IN B H - N + 1 for n < H	Table of Depreciation Pactors (DF)
TDC - Tax Depreciable Capital, dollars DF - Depreciation Pacter	7/(1 + 11)1	Weer of Payment n N 1 2 3 4 .5 6 7 8 9 10 11 12 13 14 15
M = Depreciation Life, years		3 .25 .36 .37 0 0 0 0 0 0 0 0 0 0 0 0 0
	•	14 .12 .10 .10 .10 .09 .09 .09 .09 0 0 0 0 0 0 0 0 0 0 0
		חל ום הפנס נפן פון ע מנפענהן נשמע וי
Degreciation Life Selection	H may be any integer	Allowed values of N are 3, 5, 10, and 15 Methodology selects next lower allowed N if imput N is between allowed N N = 3 applies to wehicles N = 5 applies to third party and most private wentures N = 10 and N = 15 apply to utilities and long-life private wentures

⁽¹⁾ Startup (Duner's) costs are assumed to include 40 percent depreciable capital and 60 percent nondepreciable capital.

(2) In the accelerated capital recovery system, half the investment tax credit mint be subtracted in computing depreciable capital.

COALR permits the user to specify a percentage for an investment credit to reduce income tax during the construction period. This credit is subtracted from the total capital requirement to obtain the actual cost to investors.

2.7 ANALYSES OF COSTS AND BENEFITS

In addition to calculating the life cycle costs of a coal-use project, COALR compares the coal-use project with burning oil or gas in existing boilers in a year-by-year analysis of costs and benefits. The analyses of costs and benefits are carried out to calculate comparison financial statistics, which are the savings/investment ratio and payback periods.

2.7.1 Navy Comparison Statistics

In the Navy analysis, the operating costs that would be paid for the oilor gas-burning unit are calculated as benefits to the coal-use project, since the coal-use project. The benefits occur during the operating period when oil or gas is displaced by the coal-use project. The year-by-year annual savings caused by the coal-use project are then calculated as the difference between the annual benefits and the annual coal-use project operating and maintenance costs. The present values of the savings in each year are then calculated. COALR finally calculates the savings/investment ratio and discounted payback period financial statistics in the following ways in the Navy analysis:

- The savings/investment ratio is the ratio of the total present value of savings to the total present value of the investment. If the savings/investment ratio exceeds 1.0, the coal-use project is financially attractive.
- The discounted payback period is the time until the cumulative present value of the savings becomes equal to the present value of the investment. If the discounted payback period is less than the operating life, the project is attractive.

2.7.2 Commercial Comparison Statistics

In the commercial economic analysis, the operating costs for burning oil or gas are considered as revenues for the coal-use project, under the assumption that the products of the coal-use project could be sold for the price of making them by burning oil or gas. The equivalent of "savings" in commercial economics is the after-tax cash flow.

COALR makes calculations of both of the following commercial economic equivalents of savings:

- The after-tax cash flow (common in the regulated electric utility industry)
- The equity after-tax cash flow (common in unregulated industries, such as petroleum)

The after-tax cash flow is:

$$A = (1 - t)(R - E) + tD + tI$$

where

A = annual after-tax cash flow

t = the tax rate

R = total annual revenues

E = annual expenses

D = annual capital depreciation for tax purposes

I = annual interest paid on debt

In the after-tax cash flow analysis of COALR, the present value of each annual after-tax cash flow is calculated year by year using the weighted cost of capital as the discount rate. Then COALR calculates savings/investment ratio, discounted payback period, and simple payback period financial statistics:

- The savings/investment ratio is the ratio of the total present value of operating period after-tax cash flows to the present value of the investment. As before, the coal-use project is economically attractive if the savings/investment ratio is greater than 1.0.
- The discounted payback period is the time until the cumulative present value of the after-tax cash flows becomes equal to the present value of the investment.
- The simple payback period is the time until the cumulative after-tax cash flow becomes equal to the present value of the investment.

The equity after-tax cash flow analysis in COALR differs from after-tax cash flow analysis in the following ways:

- The equity after-tax cash flow equals the after-tax cash flow minus debt service.
- Only the equity portion of the investment is used to compute the savings/investment ratio and payback periods.
- The discount rate is the return on equity.

I THE THE PARTY INTEREST TO SERVICE THE PARTY WAS TO SERVICE THE PARTY OF THE PARTY

Section 3

INPUT DESCRIPTION

This section describes the format, preparation, and use of the input data for COALR. Figure 3-1 is the complete set of input data for the first example run in Appendix A of this manual. Figure 3-1 is provided for reference during the discussions of this section. Input data for COALR may be prepared either as punched cards or as data files created from a time sharing terminal. In the discussion of this section, lines of input information are referred to as "cards," and the collection of input cards is referred to as the input "deck."

3.1 PROBLEM-ORIENTED UNFORMATTED INPUT

COALR employs an easy-to-use input system taken from a previous NCEL computer program developed by Peter F. Loftus Corporation (Ref. 3-1), which offers the following convenient features:

- A problem-oriented input language
- Unformatted data

Problem-Oriented Input Language. This includes division of the input deck into eight logically distinct data sections, and identifies input data by key words that serve both to document input variables for the user and to identify the variable to the program.

Four types of input information are supplied in the problem-oriented language:

• <u>Declarations</u>. Each declaration consists of a word or phrase called a "key word." The declaration stands alone, with no numerical values following. Each declaration sets a condition variable in the program.

```
EXAMPLR CASE 1
PLANT DATA
PEAK LOAD 200. LOAD FACTOR .50
COAL DATA
PRICE 53.80
             DIR 5.
UTILITY DATA
OIL 1.0876 DIR 8.
GAS 4.62 DIR 10.
ELECTRIC .06042 DIR 6.
STEAM 10.3
            DIR 6.
MANHOURS 30.
ECONOMIC DATA
STARTUP YEAR 1987 MONTH 11
DISPLAY YEAR 1982 MONTH 11
COST INDEX 315.0
SCHEDULE 63.0 37.0
LIFE 25. SALVAGE O. DISCOUNT 10.
REFORMULATION DATA
CONSTRUCTION 14950 INDEX 216.8
STARTUP 1640 INDEX 216.8
COAL 1540 RATE 30. * $/T
              RATE .033 * $/KWH
ELECTRIC 140
        RATE 2.37 * $/1000-5CF
GAS 10
        RATE .4734 + $/GAL
DIL 10
STEAM 10 RATE 6.00 * $/1000-LB
LABOR 1135 RATE 20. * $/HR
OTHER ANNUAL 800 INDEX 216.8
COMPARISON DATA
BURN DIL
COMMERCIAL DATA
INFLATION 6.0
DEBT 30 INTEREST 11. RETURN 18.
THIRD PARTY LEASE LIFE 15.
INCOME TAX RATE 50. CREDIT 10
PROPERTY TAX PERCENT 2.
DEPRECIATION ACRS LIFE 5
END CASE
```

TOTAL PROCESSES ACCURATE VALUE OF THE PARTY OF THE PARTY

Figure 3-1 INPUT DATA

- Variables. Each variable consists of a word or phrase called a "key word," followed by one or more numerical values.
- Case Titles. A case title is supplied for each distinct case run.
- Comments. Comments aid user documentation and are ignored by the program.

In the discussion that follows, declarations and variables are referred to as "data items."

Unformatted Data. This feature relieves the user of concern about the column in which data is punched and allows the user freedom to provide information on one or several lines, and to include comment information on the same line as data. The input deck is processed by the Peter F. Loftus INFREE free-field input routine, which interprets information according to the following rules:

- Data may be punched anywhere on a data card.
- Data items may be key words or numbers.
- Data items are separated by a comma, an equal sign, and/or one or more blank spaces.
- Numeric items may be supplied with or without decimal points.
- Numbers in exponential format are supplied by adding a plus or a minus sign followed by the exponent (e.g., 3.4-2 for 3.4 x 10⁻²).
- If an alphabetic item contains imbedded spaces, commas, or equal signs, or if it consists only of numbers and plus or minus signs, it should be enclosed by slashes (e.g.,/lA, BC DEF/ or /1234-71/).
- Data items may be repeated on a card by a specification of the form N*D, where N is the number of times data item D is to be repeated.
- Except for the title card, any cards with an asterisk
 (*) or dollar sign (\$) in column 1 are treated as
 comment cards. Information on such a card is printed
 in the input echo portion of program output, but is
 ignored by the program.

- A data card may be terminated by an asterisk or dollar sign preceded and followed by a space. All information to the right of the asterisk or dollar sign on such a card is treated as a comment and will be printed in the input echo but will be ignored by the program.
- Data may be continued on more than one card by punchinga blank followed by a plus sign (+) as the last data item on a card not including comments. For example, the following three cards:

DEBT 30 +
INTEREST 11 +
RETURN 18

are equivalent to

DEBT 30 INTEREST 11 RETURN 18

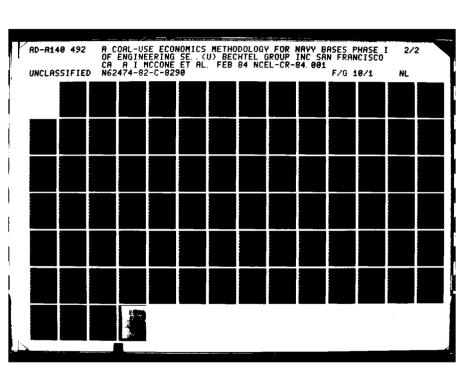
3.2 INPUT DECK ORGANIZATION

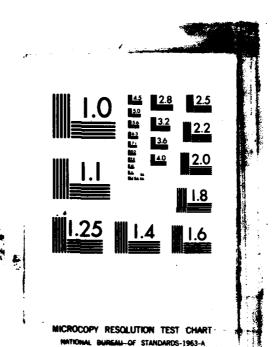
The input data deck for a given run (or "job") may contain a data set for a single case, or it may contain data sets for several cases to be processed in series. The data set for a case is terminated either by the declaration "END CASE" or by "END JOB." After the last data set of the run, supply "END JOB." After each prior data set, supply "END CASE."

The data set for each case is divided into the following eight sections:

- Title and descriptive information
- Plant data
- e Coal data
- Utility data
- Economic data
- Reformulation data
- Comparison data
- e Commercial data

The title and descriptive information section must come first. The other sections may be presented in any order. Some sections may be omitted;





such sections will be clearly noted in the descriptions below. Within a section, data items may be omitted unless otherwise noted. When a data item is to be omitted, both the key word and any numerical values following it should be omitted. The discussion below will indicate the default values of all variables.

3.3 TITLE AND DESCRIPTIVE INFORMATION

The title and descriptive information section must be the first section of a case data set. The first card must be the title card. It must have an asterisk (*) or dollar sign (\$) in Column 1. The remaining columns of the card contain the title that will be printed at the top of output pages.

The user may put additional comment cards in this section to describe the case and the purpose of the run. These cards will appear in the input echo but will be ignored by the program

3.4 PLANT DATA

THE PROPERTY OF THE PROPERTY AND ADDRESS.

Section 1. Control of the Control of

The first entry for the plant data section is the following declaration appearing by itself on the first card of the section:

PLANT DATA

The next card contains two variables as data items. The card is as follows, where r denotes a real number:

PEAK LOAD r1 LOAD FACTOR r2

The order of data items on the card is not important. If a data item is omitted, a default value is supplied by the program.

The definitions of the variables on the first card are as follows:

Key Word	Numerical Value	<u>Definition</u>	Units	Default Value
PEAK LOAD	rl	Peak heating steam load of the plant	1000-1b hr	. 0.0
LOAD FACTOR	r2	Annual plant load factor	decimal fraction	0.0

Note that the information on card 1 could be placed on a single card, or could appear on two cards in any order.

3.5 COAL DATA

This section describes the coal to be used. The first card of the section must contain the declaration

COAL DATA

On a subsequent card in the section, the user supplies the following, where r signifies a real number:

PRICE rl DIR r2

These variables are defined as follows:

Key Word	Numerical Value	Definition	<u>Units</u>	Default Value
PRICE	rl	Delivered price of coal	\$/ton	0.0
DIR	r2	Differential inflation rate of coal	%/yr	0.0

3.6 UTILITY DATA

A STATE OF THE PROPERTY OF THE

This section provides rate information for labor, purchased energy, water, and scrubber chemicals. The first card of the section must contain the following declaration:

UTILITY DATA

Subsequent cards that may be supplied are as follows, where r signifies a real number:

MANHOURS r1
ELECTRIC r2 DIR r6
GAS r3 DIR r7
OIL r4 DIR r8
STEAM r5 DIR r9

The rate variables in the cards above are defined as follows:

Key Word	Numerical Value	Definition	Units	Default Value
MANHOURS	rl	Labor rate	\$/manhour	0.0
ELECTRIC	r2	Electricity rate	\$/kWh	0.0
GAS	r3	Natural gas rate	<pre>\$ per thousand standard cubic feet</pre>	0.0
OIL	r 4	Fuel oil rate	\$/gallon	0.0
STEAM	r5	Auxiliary steam rate	\$/1000-1ь	0.0

All rates must be in display year dollars. The key work DIR on the cards above denotes the differential inflation rate for the purchased energy commodity preceding it on the line. The numerical values r6, r7, r8, and r9 are expressed in percent per year.

The default value for each DIR is zero.

3.7 ECONOMIC DATA

This section describes economic parameters. The first card of this section contains the following declaration:

ECONOMIC DATA

Three cards must now be supplied. The data items on each card must be supplied in the order shown. The three cards are:

STARTUP YEAR il MONTH i2 DISPLAY YEAR i3 MONTH i4 COST INDEX rl

In the above, i designates an integer and r designates a real number.

The integers on the first and second cards above are input as follows:

il - the startup year, in four digits

i2 - the startup month, an integer between 1 and 12
 (if omitted, 1 is assumed)

i3 - the display year, in four digits

i4 - the display month, an integer between 1 and 12 (if omitted, 1 is assumed)

The cost index card presents a value for the cost index published by Chemical Engineering Magazine.

The number rl on the cost index card is the display year value of the cost index.

Following the three cards above, a schedule card must be supplied. This card has the form:

SCHEDULE rl r2 r3 r4 r5

The numbers r1, r2, etc. are percentages of the construction costs in years preceding startup of plant operation, counting <u>backwards</u> from startup. The percentages must add up to 100 percent. For construction periods shorter than five years, only those percentages that are nonzero must be entered.

Three additional data items may be supplied on one or more card in any order. Shown on a single card, these are as follows:

LIFE rl SALVAGE r2 DISCOUNT r3

Here, r designates a real number. The variables are defined as follows:

Key Word	Numerical Value	Definition	Units	Default Value
LIFE	rl	Economic life of the plant	Years	25.0
SALVAGE	r2	Salvage value of plant at end of economic life	Thousands of dollars	0.0
DISCOUNT	r3	Navy constant dollar discount rate	Percent/year	10.0

3.8 REFORMULATION DATA

CONTRACTOR DESCRIPTION OF THE PROPERTY OF THE

This section presents coal-use project costs that will be reformulated by COALR. The first card of the section is the declaration:

REFORMULATION DATA

The following additional cards are then supplied, where r signifies a real number:

Construction	rl	INDEX	r10
Startup	r2	INDEX	rll
Coal	r3	RATE	r12
Electric	r 4	RATE	r 13
Gas	r5	RATE	r14
0i1	r6	RATE	r15
Steam	r 7	RATE	r16
Labor	r8	RATE	rl7
Other Annual	r9	INDEX	r18

The variables on the left are the coal-use project costs in the dollars of some reference year. The variables are defined as follows:

Key Word	Numerical Value	Definition	Units	Default Value
CONSTRUCTION	r1	Total construction cost	\$1000	0.0
STARTUP	r2	Startup cost	\$1000	(11 percent of construction)
COAL	r3	First year coal cost	\$1000	0.0
ELECTRICITY	± 4	First year electricity		
		cost	\$1000	0.0
GAS	r 5	First year natural gas	•	
		cost	\$1000	0.0
OIL	r6	First year fuel oil cost	\$1000	0.0
STEAM	r7	First year auxiliary	•	
		steam cost	\$1000	0.0
LABOR	r8	First year labor cost	\$1000	0.0
OTHER ANNUAL	r9	First year material and subcontract costs	\$1000	0.0

The variables to the right on the cards define price levels for the reference year of the project costs. These variables are defined as follows:

Key Word	Numerical Value	<u>Definition</u>	Units	Default Value
INDEX	r10	Cost index for construction	dimensionless	0.0
INDEX	r11	Cost index for startup	dimensionless	0.0
RATE	r12	Price of coal	\$/ton	0.0
RATE	r13	Price of electricity	\$/kWh	0.0
RATE	rl4	Price of gas	<pre>\$ per thousand standard cubic</pre>	
			feet	0.0
RATE	r15	Price of oil	\$/gallon	0.0
RATE	r16	Price of auxiliary steam	\$/10 ³ 1b	0.0
RATE	r17	Price of labor (including		
INDEX	rl8	benefits and supervision) Cost index for first year	\$/manhour	0.0
		material and subcontracts	dimensionless	0.0

The cost index to be used is that published by Chemical Engineering magazine. If a price level variable is 0.0, the program will assume that the corresponding project cost variable is in display year dollars.

3.9 COMPARISON DATA

CANADA MANAGA SANGARA MANASA ABACTAR

This section determines the type of base case against which the coal-use plant is compared. The first card of this section contains the declaration:

COMPARISON DATA

The next card contains one of the following two alternative declarations:

Alternative Declaration	Interpretation
BURN OIL	A base case of burning fuel oil in existing boilers is selected.
BURN GAS	A base case of burning natural gas in existing boilers is selected.

3.10 COMMERCIAL DATA

This section describes private sector financial assumptions. The first card of this section contains the following declaration:

COMMERCIAL DATA

The second card of the section is:

INFLATION r1

Here, rl is the general inflation rate in percent/year.

The third card of the section defines the private sector capital structure as follows:

DEBT r1 INTEREST r2 RETURN r3

Again, r signifies a real number. The variables are defined as follows:

Key Word	Numerical Value	<u>Definition</u>	Units	Default -Value
DEBT	rl	The amount of the project capital that is financed by debt	Percent	30.0
INTEREST	r2	The current dollar rate of interest on debt	Percent per year	11.0
RETURN	r3	The current dollar rate of return on equity	Percent per year	18.0

The fourth card of the section contains one of the following two alternative declarations:

Alternative Declaration	Interpretation		
PRIVATE	A venture structure is selected that is third party financed and third party operated (all private).		
THIRD PARTY	A venture structure is selected that is third party financed and Navy operated.		

If the third party alternative is selected, the following additional variable may be supplied on the same or following card:

LEASE LIFE r1

Here, rl is the duration of the lease agreement between the third party and the Navy, expressed in years. The default value is 15 years.

The next two cards define tax information. They are of the following form, where r is a real number:

INCOME TAX RATE r1 CREDIT r2
PROPERTY TAX PERCENT r3

These variables are defined as follows:

Key Word	Numerical Value	Interpretation	Units	Default Value_
INCOME TAX RATE	rl	Federal plus state corporate income tax rate	Percent of annual tax-able income	50.0
CREDIT	r2	Investment tax credit	Percent of investment	10.0
PROPERTY TAX PERCENT	r3	Annual property tax rate	Percent of total capital requirement per year	2.0

The last card defines the calculation of depreciation for tax purposes. The card has the form:

DEPRECIATION a LIFE rl

In the above, a is one of the following two alternative declarations about the method for computing year-by-year depreciation:

Alternative Declaration	Interpretation
DEPRECIATION SOYD	The sum of the year's digits method is selected.
DEPRECIATION ACRS	The accelerated capital recovery method is selected. (The default is the ACRS method.)

On the last card above, the number rl is the plant life for tax depreciation purposes, expressed in years. The default value is 5 years.

Section 4

PROGRAM OUTPUT

This section describes the output of COALR. The basis for the discussion in this section will be the example of the output of two typical run cases, selected to demonstrate both commercial options of the program. The outputs for these two cases are Tables A-1 and A-2 in Appendix A.

The output of the example run contains the following parts:

- An echo of input data
- Financial analysis reports

Each of these parts is described briefly below.

4.1 INPUT DATA ECHO

The first part of each output is the input data echo. The input data echo is divided into two segments:

- Blind echo
- Interpretive echo

The blind echo is merely an immediate reprinting in the output of the data fed in as input. The blind echoes of the example runs are shown on the first page of Table A-1 and the first page of Table A-2 under the heading "Input Data Listing." For both examples, the input was prepared in the sequence indicated in Section 3. The example input makes extensive use of comments in order to clearly label the units and interpret input variables and declarations. This procedure may be useful for other users.

The interpretive echo proves to the user that his input data has been correctly stored in program internal variables. In Table A-1 the interpretive echo is displayed in three pages.

4.2 FINANCIAL ANALYSIS REPORTS

The final part of the output presents the financial analyses reports generated by the coal-use economics methodology developed under Phase I of the contract (References 2-4 and 2-5). The last 9 pages of Table A-1 present the financial analysis reports generated for the first example case. The reports in Table A-1 describe the following two ventures which can be compared side-by-side:

- A Navy financed/Navy operated venture
- A third party financed/Navy operated venture

The titles of the reports in Table A-1 are as follows:

- Navy present values in display year dollars
- Navy levelized costs in display year dollars
- Navy life cycle cost and benefit analysis
- Navy present values in startup year dollars
- Navy levelized costs in startup year dollars
- Third party financing investor cash flows during contruction period
- Third party financing investor cash flows during operating period
- Third party financing Navy cash flows during operating period
- Summary: Navy financed/Navy operated venture vs. third party financed/Navy operated venture

The reports for the second case describe the following two ventures which can be compared side by side:

- A Navy financed/Navy operated venture
- A privately financed/privately operated venture

For the second example case, COALR generates the same Navy reports as in Table A-1. Table A-2 contains only resports for the second example case which are different from those in Table A-1. These are as follows:

- Private venture investor cash flows during construction period
- Private venture cash flows during operating period
- Private venture minimum revenue requirement discounting with weighted cost of capital
- Private venture minimum revenue requirement discounting with return on equity
- Summary: Navy financed/Navy operated venture vs privately financed/privately operated venture

Section 5

PROGRAM EXECUTION

This section presents instructions for executing COALR on the computer designated KWA at Control Data Corporation's Western Cybernet Center in Sunnyvale, California. Instructions are provided for execution in either of the following modes:

- Batch
- Demand (through the SUBMIT command)

Instructions are provided for the following three operations:

- Run COALR with user input cases
- Run COALR with EXAMPLR sample input cases
- Generate a compilation listing of COALR

The instructions for the operations above utilize the procedure file COALPRC, which is a permanent public file under user number L6016GS. Procedures in File COALPRC automatically retrieve program files, data tables, and sample and test input data from a program tape and provide routine control statements to complete a run.

5.1 BATCH MODE EXECUTION

Batch mode execution is accomplished by submission of a deck of run cards. This run deck consists of the following set of cards in the order shown:

- Identification cards
- Procedure cards
- An end-of-record card

- Input data cards
- An end-of-information card

Each of these is discussed below.

5.1.1 Identification Cards

Table 5-1 displays typical identification cards for use of COALR. The table provides a brief explanation of the contents of each card. This explanation is provided for information only. Since several of the cards are user-specific and installation-specific, the user must consult local Control Data Corporation representatives for assistance in preparing correct identification cards.

5.1.2 Procedure Cards

These cards will perform the required operations to run COALR. They are the same in batch and demand mode. They are discussed in Section 5.3.

5.1.3 End-of-Record Card

After the last procedure card, an end-of-record card must be placed. It consists of the numerals 7, 8, and 9 punched in column 1. It is used if input data cards follow.

5.1.4 Input Data Cards .

User input data cards are placed after the end-of-record card. If the procedure needs no user input data, or if the required data is to be obtained from a disc file, no input cards are to be provided, and the preceding end-of-record card is deleted.

5.1.5 End-of-Information Card

A CONTRACT TO THE PROPERTY OF THE PROPERTY OF

After the last input data card (or last procedure card if there are no input data cards), an end-of-information card must be placed. It consists of the numerals 6, 7, 8, and 9 punched in column 1.

Table 5-1

TYPICAL BATCH MODE IDENTIFICATION CARDS

Explanation	JOB indicates the start of information for a job. P4 indicates assignment of job priority 4. TI00 indicates a limit of 100 seconds for the job. STKWA indicates that the job will utilize the Sunnyvale computer designated KWA. The terminal period indicates the end of the job control card. Each control card in a batch deck must end with a period.	USER indicates that user identification data follows. XX999YY is a typical form of user number. PASSWORD is the user's password. KWA indicates that the user number is assigned to computer KWA.	CHARGE indicates that user accounting data follows. WW99922 is a typical form of charge number. *QQ*PN999 is a possible form of program and individual user number.	ROUTE indicates that the output should be printed at a location other than the Sunnyvale computer center. OUTPUT is the name of the file to be routed. DEF indicates that routing is deferred until the run is complete. DC=PR indicates that the output device is a printer. ST=WCZ indicates the Sunnyvale output queue holding the output. UN=MKIVPW indicates that that the printer is in the San Francisco data center. FID=HYNAME indicates that MYNAME is to be printed on the output.	HEADING indicates that a heading is to be printed on the first run page. The period after HEADING ends the heading command. H is the character used to print the heading. I indicates that the heading will be printed at the top of the next page. MYNAME is the heading to be printed, up to 10 characters; the user's name is the heading recommended.	GET indicates that a data file is to be made a local file for the user's run. FILENAM is the name of the data file.
Card Contents	JOB, P4, T100, STKWA.	user, XX999ty , Passhord , kha.	Charce, w19992z, *QQ9* PN999.	ROUTE, OUTPUT, DEF, DC=PR, ST=4CZ, UN=1KIVPW, FID=MYNAME.	HEADING.MIMYNAME (This card is optional.)	GET, FILKNAM. (This card is optional, and is used if input data is on disc rather than on cards.)
Card	-	8	m	4	w	•

5.2 DEMAND MODE EXECUTION

Demand mode execution from a timesharing terminal is accomplished by the following steps:

- Creation of a disc file containing the job control statements
- Submission of the file as a remote batch job

5.2.1 Creation of Job Control File

From a timesharing terminal, the user can create a job control file using the text editor (1). The file may be of either of the following two forms:

- The statements and data lines are identical to the cards of the equivalent batch job deck.
- Most statements are identical to cards in the equivalent batch job deck. An interpretive feature permits substituting commands that may be shorter for some statements.

Table 5-2 describes a typical demand mode job control file that includes the interpretive feature. When working from the terminal, it is usually most convenient to prepare input data as a separate file rather than to include it in the job control file. In that case, the data file is brought into the job by the GET command shown in Tables 5-1 and 5-2.

5.2.2 Submission of Job Control File

Submission of the job from the terminal is accomplished by the lines shown in the following example:

GET, JCFILE SUBMIT, JCFILE

⁽¹⁾ For instructions on the use of the XEDIT text editing system, the user should consult Control Data Corporation documentation.

Table 5-2

THE CONTROL OF THE SECOND CONTROL SECOND SECOND

TYPICAL DEMAND MODE JOB CONTROL FILE

Line		Line Contents	Explanation
32.1	/JOB JOB, P4, T100. /USER		This announces the use of the interpretive feature. This line is substituted for the batch mode JUB card. This line commands the computer to retrieve user number, password, and computer assignment from the terminal session submitting the job.
₫ .	/CHAKGE		This line commands the computer to retrieve accounting data from the terminal session submitting the job.
w	ROUTE,OUTPUT,DEF,DC=PR,ST=WC HEADING.MIMYNAME (Optional) GET,FILENAM. (Optional)	ROUTE, OUTPUT, DEF, DC-PR, ST-WCZ, UN-MKIVPW, FID-MYNAME. HEADING. MIMYNAME (Optional) CET, FILENAM. (Optional)	These lines are identical to the corresponding batch mode cards.
g,8	(Procedure lines)		These lines are identical to the corresponding batch mode cards.
4 + 13	/EOR	(Optional)	This line substitutes for the end-of-record batch mode card.
n + 2,,	n + 2,,m (Data lines)	(Optional)	These lines are identical to the corresponding batch mode cards.
• • 1	/EOF		This line substitutes for the end-of-informstion batch mode card.

In the first line, the GET command brings the disc file named JCFILE into the user's computer workspace. JCFILE is the file of job control statements. In the second line, the SUBMIT command submits file JCFILE as the job control statements for a remote batch job.

5.3 PROCEDURE STATEMENTS

Procedure file COALPRC contains a series of procedures to carry out operations with COALR. Brief procedure statements will then permit the user to execute the procedures. The following paragraphs explain the procedure statements for three operations with COALR.

5.3.1 Run with User Input Cases

To run COALR with input cases prepared by the user, include the following procedure statements as cards or file lines:

GET, COALPRC/UN=L6016GS.
BEGIN, RUSRDAT, COALPRC, I=FILENAM.

In the first card, the command GET makes the procedure file COALPRC a local file for the user's run. In the second card, the command BEGIN executes a procedure named RUSRDAT which is found in file COALPRC.

FILENAM is the name of the user's file containing input cases. This file may be on disc, or it may be the file created when input data cards or lines are read into the computer with the job control deck.

5.3.2 Run with EXAMPLR Sample Input Case

The sample output of Appendix A is generated by a run with an input data file labeled EXAMPLR. To replicate that run, include the following procedure statements as cards or file lines:

GET, COALPRC/UN=L6016GS.
BEGIN, RXPLDAT, COALPRC.

In the first card, the command GET makes the procedure file COALPRC a local file for the user's run. In the second card, the command BEGIN executes a procedure named RXPLDAT which is found in file COALPRC.

5.3.3 Generation of Compilation Listing

To generate a compilation listing of COALR, include the following procedure statements as cards or file lines:

GET, COALPRC/UN=L6016GS
BEGIN, RLSTCOD, COALPRC.

In the first card, the command GET makes the procedure file COALPRC a local file for the user's run. In the second card, the command BEGIN executes a procedure named RLSTCOD which is found in file COALPRC.

5.4 RESOURCES REQUIRED TO EXECUTE PROCEDURES

Table 5-3 indicates the computer resources required to execute principal COALR procedures.

Table 5-3

COMPUTER RESOURCES REQUIRED
TO EXECUTE COALR PROCEDURES

Procedure Executed	Words of Core	Central Processor Time, Seconds	Billing <u>Units</u>	Input/ Output · Data Blocks
Run COALR with EXAMPLR as input (contains four cases)	51,300	15	13	120
Compile COALR	62,000	50	40	560

(1) One input/output data block consists of 1280 characters.

Section 6

ERROR PROCESSING

6.1 INPUT EDITING ERROR MESSAGES

Table 6-1 lists and interprets error messages that assist in assuring integrity of the input data. The input editing is performed by the program during a run. The occurrence of an error message indicates that the input should be corrected and a new run submitted.

6.2 CALCULATION ERROR MESSAGES

The program contains no error messages generated during calculations.

Table 6-1

INPUT ERROR MESSAGES

Message	Interpretation
Infree error character, n, "string"	The nth character in "string" cannot be interpreted
Error - cannot process word n on the above card	The nth word on the input card cannot be interpreted
Error - word n on the above card should be numeric	Self explanatory
Error - word n on the above card should be alphabetic	Self explanatory
Error - word n on the above card is missing	Self explanatory
Error - schedule values do not add up to 100 percent	The percents of spending during construction years do not total 100 percent. The life cycle costs will be erroneous

Section 7

TEST PROCEDURES

COALR was tested by detailed hand check of all major calculations and program options, and spot check of program logic and calculations in minor options.

Correct functioning is demonstrated for major options by the four sample cases in the EXAMPLR run in Appendix A, as shown in Table 7-1. The four sample cases generate all the reports available from COALR, and exercise the options that will be used most frequently. The calculations subjected to hand check for the major options are described in Table 7-2. The extensive intermediate details in the reports generated by COALR lend themselves to direct independent check, which the reader can reproduce.

Spot checks for minor options are described in Table 7-3. A special case run was made to test each minor option, and correct function was demonstrated.

Table 7-1

MAJOR OPTIONS DEMONSTRATED BY RUN EXAMPLR

		EXAMPL	R CASE	
Option Demonstrated	_1_	_2_	_3	4
Third party financed/Navy operated venture	x		x	x
Privately financed/privately operated ventures		x		
Depreciation calculated by the accelerated capital recovery system (ACRS)	x	x		x
Depreciation calculated by the sum-of-the- years-digits (SOYD) method			x	
Oil-fired base case	x	x	x	
Gas-fired base case				x

Table 7-2

CALCULATIONS VERIFIED BY HAND CHECK FOR MAJOR PROGRAM OPTIONS

	_ ·
Calculation	Method of Verification
Reformulation of project cost data	Calculation of display year costs from indices, rates, input costs
Navy present values	Calculation of discount factors from formula, Navy tables (Ref. 7-1)
Navy levelized costs	Calculation of levelizing factors
Navy year-by-year costs and benefits analysis	Check calculations for first, last, and representative intermediate years; check of statistics formed from totals
Commercial cash flows during construction period	Check of all table entries
Third party cash flows during operating period	Check calculations for total levelized lease, and for first, last, and key intermediate years
Navy cash flows during operating period	Check of Navy present value of lease payments for key years, check of statistics formed from totals
Private venture cash flows during operating period	Check calculations for first, last, and key intermediate years; check of statistics formed from totals
Private venture minimum revenue requirements	Check of all present value and levelizing factors, check of all sums, products, and quotients
Summeries	Check of all table entries

Table 7-3

MINOR OPTIONS VERIFIED BY SPOT CHECK

Minor Option	Feature Verified
Non-zero salvage value	Correct treatment in each report
Display year that follows the startup year	Correct discount factors
Omitting several operating cost items from UTILITY DATA and REPORMULATION DATA	Correct default values
Cogeneration	Correct handling of net cogeneration

Section 8

CODE DESCRIPTION

This section describes the code of COALR and includes the following topics:

- Hierarchy diagram
- Subroutine descriptions
- Logic flow diagrams
- Common blocks
- Files

8.1 HIERARCHY DIAGRAM

Figure 8-1 is a hierarchy diagram for COALR. The diagram indicates the calling hierarchy of subroutines and functions. The executive routine is COALR. Routine COALR calls subroutines below it that are connected to it by solid lines. These subroutines in turn may call other subroutines or functions further below, etc., down to three levels of subordination. On the diagram, rectangles are used for the executive routine, block data, and subroutines. Ovals are used for functions.

During a run COALR calls subroutines from left to right along the diagram. The subroutines called by COALR fall into the following four groups:

- The message routine
- Case run input routines
- The cost reformulation routine
- Financial analysis routines

Figure 8-1 COALR HIERARCHY DIAGRAM

Market Market Indiana Indiana

8.2 SUBROUTINE DESCRIPTIONS

The subroutines and functions in the program are described briefly below.

8.2.1 The Message Routine

MESAGR writes an identification block on the front page of each program run.

8.2.2 Case Run Input Routines

INPR1 reads plant, coal, and utility input data and stores it in internal variables. INPR2 reads economic data on schedule and Navy financial parameters. INPR3 reads reformulation data, comparison data, and commercial data. WRTINR writes the interpretive echo of the case input data.

Four utility routines assist input interpretation. LINP examines each new line of input to determine whether it is a section declaration.

INFREE actually reads each new line character by character and separates words from numbers. LINPS compares input words with expected key words within each section of data. LINPCK checks whether a variable is numeric or alphanumeric.

8.2.3 The Cost Reformulation Routine

The cost reformulation routine CALCR converts the reformulation project costs into display year dollars.

8.2.4 Financial Analysis Routines

ECONR serves as an executive routine to manage calls to the financial routines. NECON1 calculates present values and levelized costs for a Navy financed/Navy operated venture. NECON2 calculates year-by-year costs and benefits for such an all-Navy venture. SA calculates the Navy discount factor for a one-time cash flow. CUS calculates the Navy cumulative uniform series discount factor for a series of annual cash flows.

Commercial economic calculations are carried out by 11 subroutines and functions. CECON1 calculates private venture minimum revenue requirements. CECON2 calculates private or third party investor cash flows during the construction period. CECON3 calculates third party investor cash flows during the operating period. CECON4 calculates private venture cash flows during the operating period. CECON5 calculates Navy cash flows during the operating period for a third party financed/Navy operated venture. ECONS prints summary reports.

Five utility functions assist the commercial economic calculations.

DEPFAC calculates the fraction of capital depreciated each year. AFROMP calculates the factor to form an annuity from a present value. PFROMA calculates the factor to form a present value from an annuity. PFROMF calculates the factor to form a present value from a future value.

FFROMP calculates the factor to form a future value from a present value.

8.3 LOGIC FLOW DIAGRAMS

This section provides logic flow diagrams for the financial calculations that were sumarized in Figure 1-3. Figure 1-3 showed that project costs are reformulated to display year dollars in subroutine CALCR, and then all financial calculations are made by or called from ECONR. Figures 8-2 through 8-8 (presented at the end of this section) provide logic flow diagrams for subroutines NECON1, NECON2, CECON2, CECON3, CECON5, CECON4, and CECON1, respectively.

8.4 COMMON BLOCKS

COALR has a number of blocks of common variables that are shared by program routines. Incidence Table 8-1 presented at the end of this section lists the common blocks and routines and indicates where they coincide.

8.5 FILES

COALR is composed of a number of files available to the user. These are stored on tape for use with Control Data Corporation's Western Cybernet Center's computer designated KWA in Sunnyvale, California. The COALR files and their functions are listed in Table 8-2 at the end of this section. The read-only program tape containing these files is designated COLCONV, and is assigned to NCEL user number L6016GS. The files are retrieved from this tape by the procedures for running the programs which are described in Section 5. Users should contact the NCEL Data Processing Center if they desire to use the tape and files in a way other than specified in the procedures.

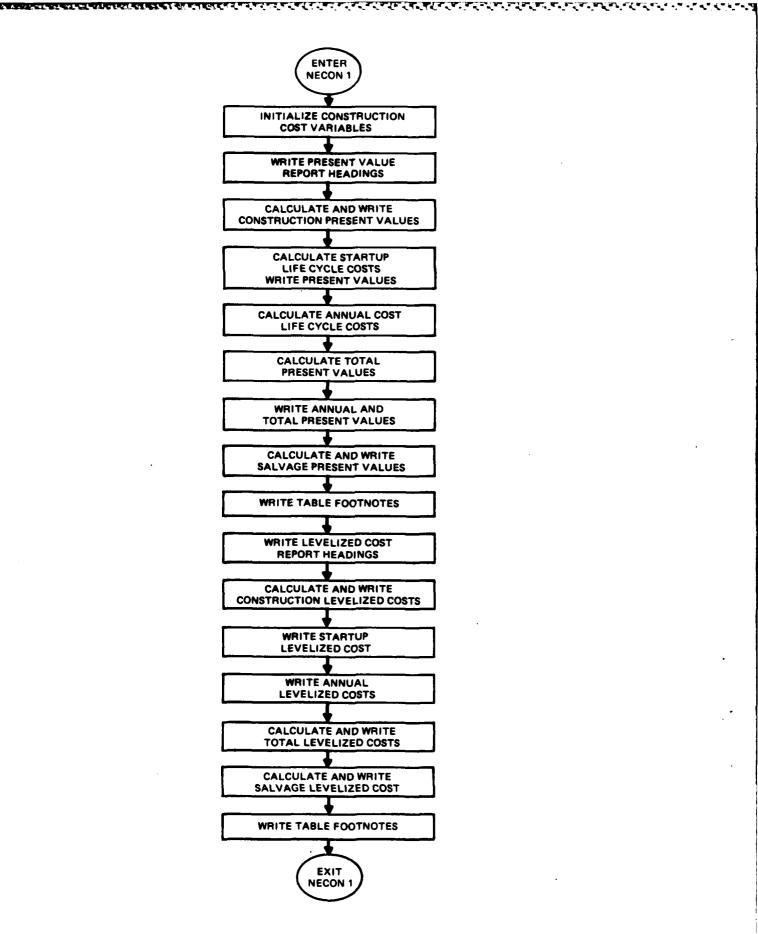


Figure 8-2 LOGIC FLOW DIAGRAM FOR SUBROUTINE NECON 1, CALCULATION OF NAVY PRESENT VALUES AND LEVELIZED COSTS (REPORTS 1,2,4 AND 5)

Selling Control (Represent Longerton) Systems

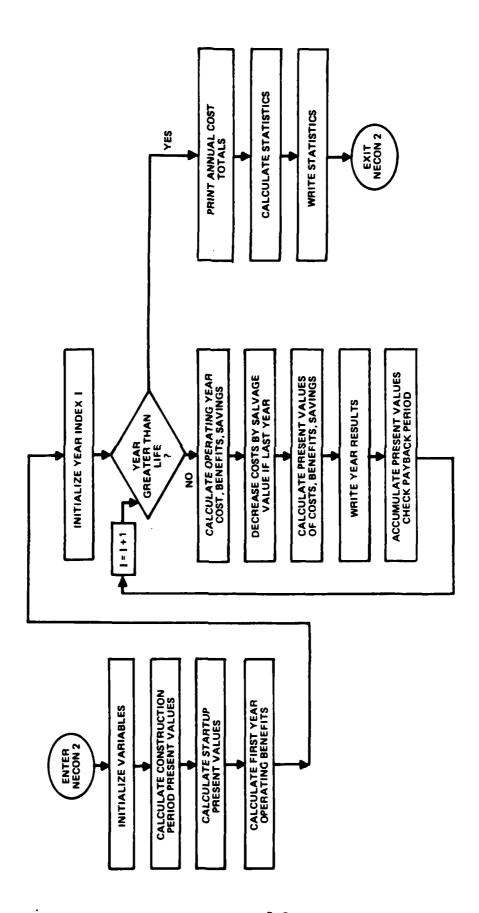


Figure 8-3 LOGIC FLOW DIAGRAM FOR SUBROUTINE NECON 2, CALCULATION OF NAVY COST AND BENEFIT ANALYSES (REPORT 3)

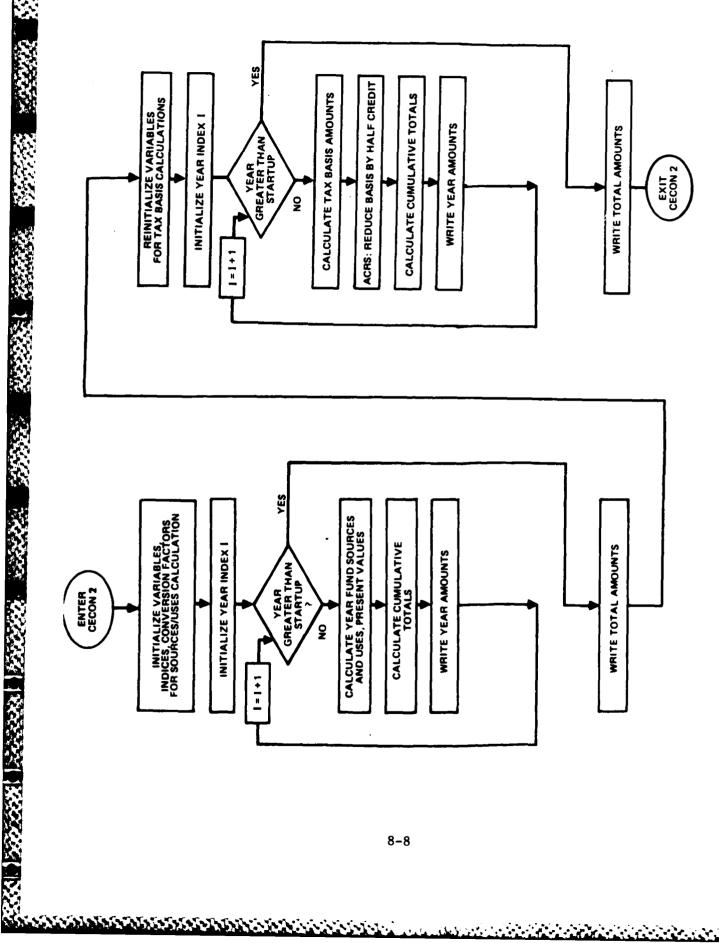
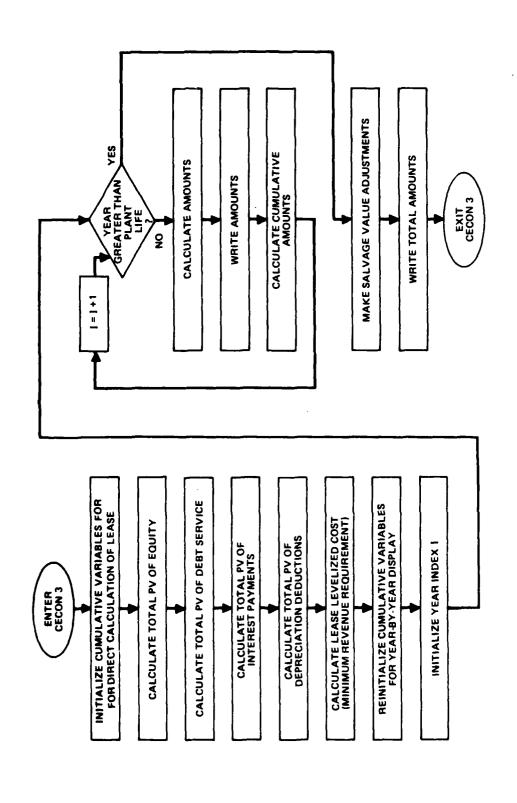
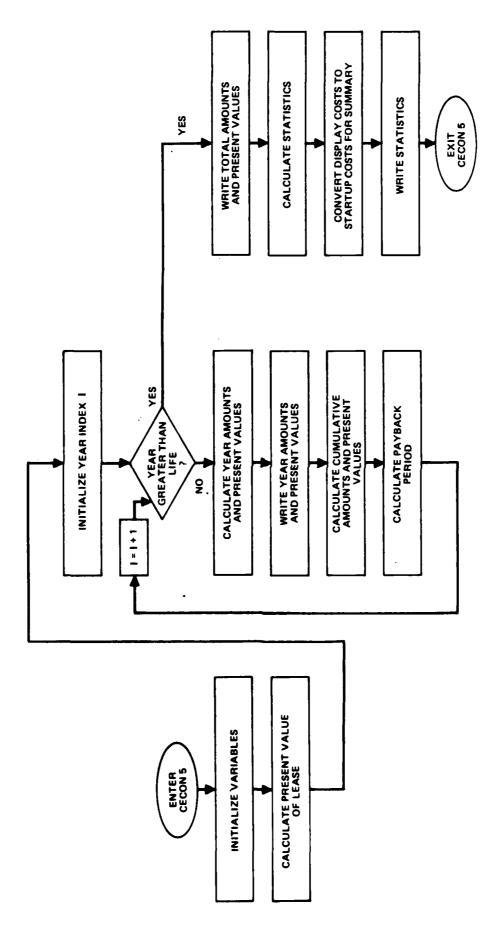


Figure 8-4 LOGIC FLOW DIAGRAM FOR SUBROUTINE CECON 2, CALCULATION OF INVESTOR FLOWS **DURING CONSTRUCTION PERIOD** (REPORTS 6 AND 9)



MANAGE SECRETA SOCIONE SESSION DECIMA NACE

Figure 8-5 LOGIC FLOW DIAGRAM FOR SUBROUTINE CECON 3, CALCULATION OF THIRD PARTY INVESTOR CASH FLOWS DURING OPERATING PERIOD



Personal Security

AND THE PROPERTY OF THE PROPER

Figure 8-6 LOGIC FLOW DIAGRAM FOR SUBROUTINE CECON 5, CALCULATION OF NAVY CASH FLOWS DURING OPERATING PERIOD (REPORT 8)

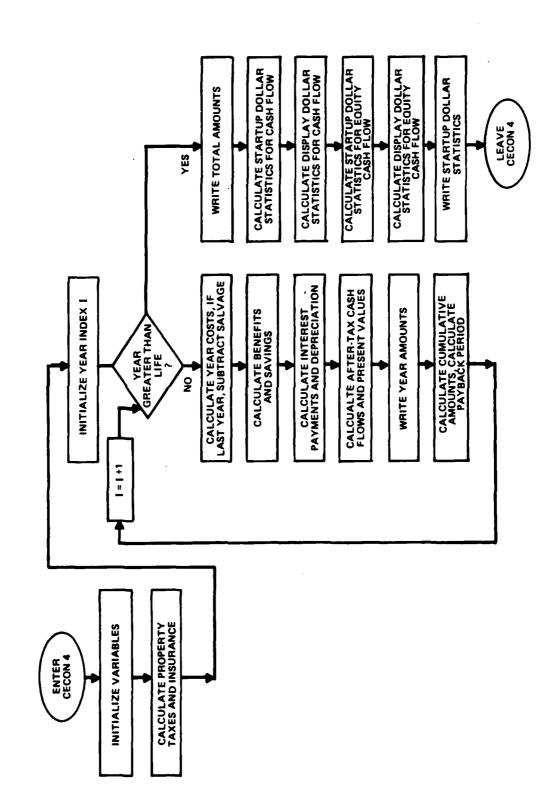
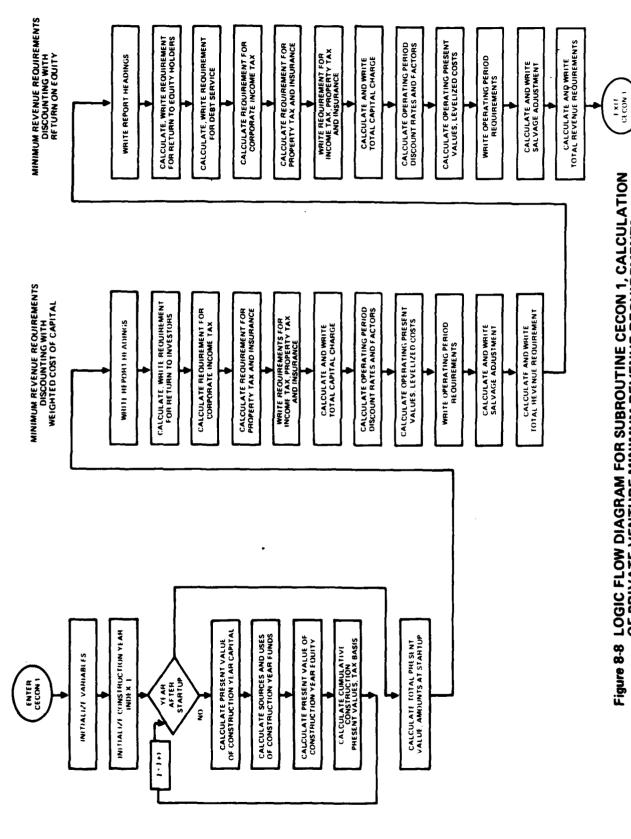


Figure 8-7 LOGIC FLOW DIAGRAM FOR SUBROUTINE CECON 4, CALCULATION OF PRIVATE VENTURE CASH FLOWS DURING OPERATING PERIOD (REPORT 10)



POSSE CONTRACTOR DESCRIPTION OF CONTRACTOR CONTRACTOR CONTRACTOR SANDERS CONTRACTOR SANDERS CONTRACTOR (SANDERS

Figure 8-8 LOGIC FLOW DIAGRAM FOR SUBROUTINE CECON 1, CALCULATION OF PRIVATE VENTURE MINIMUM REVENUE REQUIREMENTS (REPORTS 11 AND 12)

Table 8-1
COALR COMMON BLOCK INCIDENCE TABLE

Common Block

		85ECC	COALL	DAL?	OAL3	OALA	STATS	ECOM.	MOCK	S. C. Child	SCOM	it on
Routine		♣	~ ~		, (۷	у «У ———	· •	ک		. ^	- 4
COALR		X	X	X	X		X	X	X	X	X	x
BLOCK DATA		X	X	X	X				X	X		
CALCR	X	X	X	X	X					X	X	
CECON1		X	X	X	X					X	X	
CECON2	X	X	X	X	X	X				X	X	
CECON3	x	X	X	X	X	X				X	X	
CECON4	х	X	X	X	X	X				X	X	
CECON5		X	X	X	X	x				X	X	
ECONR	x	X	X	X	` X	X				X	X	
ECONS		X	X	X	X	X				X	X	
INFREE										X		x
INPR1		X	X	X.	X		X	X	X	X	X	
INPR2		X	X	X	X		X	X	X	X	X	
INPR3		X	X	X	X		X	X	X	X	X	
LINP								X		X		x
LINPS								X		X		x
LINPCK								X		X		x
MESAGR										X		
NECON1		X	X	X	X					X	X	
NECON2	х	X	X	X	X	x				X	X	
WRTINR		X	X	X	X					X	x	

Table 8-2

NAMES AND FUNCTIONS OF COALR FILES ON TAPE COLCONV

File Name	File Functions					
COALRR	Relocatable code					
COALR	Source code					
FYAMPI.P	Sample case input					

Section 9

USE OF COALR TO REPLICATE COMMERCIAL FINANCIAL ANALYSES

One of the objectives for the use of COALR is replication of coal-use project financial analyses appearing in proposals or reports to the Navy or appearing in the technical literature. The range of options and input variables provided in COALR should be sufficient to permit replication of the results of most coal-use project financial analyses prepared by others.

The difficulty of replicating a financial analysis by others will depend on the completeness of information provided on the financial input parameters used in the analysis. If all the input variables required by COALR are explicitly stated in the financial analysis, then replication should be accomplished in a straightforward manner by COALR in a single run.

If the input information is incomplete for a given financial analysis, then the user will have to determine the missing information by a trial and error procedure involving several runs of COALR. A rapidly converging trial and error procedure which the user may find convenient is the method of successive trials. This trial and error procedure is described in Appendix B.

REFERENCES

- 2-1 A Coal-Use Economics Methodology for Navy Bases, Bechtel Group, Inc., San Francisco, California, Draft NCEL Contract N62474-82-C-8290, Engineering Services for Coal Conversion Guidance, Phase I, July 1983.
- 2-2 Economic Analysis Handbook, P-442, Naval Facilities Engineering Command, 1975.
- 2-3 Slaminski, J. M., "Economic Analysis and Priority Rating Formulation for Navy Shore Facilities Energy R&D Projects," Civil Engineering Laboratory, Port Hueneme, California, November 1977.
- 2-4 Instruction for Preparation of Economic Analyses, LANTNAVFACENGCOM, 407:ARM, March 19, 1980.
- 2-5 Ward, Carter J., "Simplified Economic Analysis for Navy Shore Facilities Energy R&D Products," Civil Engineering Laboratory, Port Hueneme, California, December 11, 1979.
- 2-6 Grant, E. L., Ireson, W. G., and Leavenworth, R. S., <u>Principles of Engineering Economy</u>, Sixth Edition, John Wiley & Sons, New York, 1976, pp. 33-37.
- 2-7 Comparison of Coal Energy Conversion Technologies at Navy Bases,
 Bechtel Group, Inc., San Francisco, California, Draft NCEL Contract
 Report, Contract N62474-82-C-8290, Engineering Services for Coal
 Conversion Guidance, Phase III, July 1983.
- 3-1 <u>Coal Conversion Cost Computer Program</u>, Peter F. Loftus Corporation, Pittsburgh, Pennsylvania, Draft NCEL Contract Report, Contract N62474-81-C-9409, September 1982.
- 7-1 Economic Analysis Handbook, p-422, Naval Facilities Engineering Command, 1975.

Appendix A

COALR OUTPUTS GENERATED BY RUN WITH INPUT FILE EXAMPLE

This appendix contains four case outputs generated by a run with input file EXAMPLR. The case outputs, Tables A-1 through A-4, demonstrate all major program options, as described in Section 7.

The same project capital costs, first year operating and maintenance costs, and life cycle schedule are included in all four cases. The four cases differ only in the choices made by the user for the venture structure, the depreciation calculation method, and the comparison fuel. Since all the output deal with the same project, several reports for Cases 2, 3, and 4 are identical with those for Case 1. Accordingly, the Case 1 output is reproduced in full in Table A-1. However, in Tables A-2, A-3, and A-4, for Cases 2 through 4, only those pages are included that differ from the corresponding pages for Case 1.

Table A-1

CASE 1 - THIRD PARTY FINANCED/NAVY OPERATED VENTURE, ACRS DEPRECIATION, COMPARISON WITH BURNING OIL

INPUT DATA LISTING

```
EXAMPLE CASE 1
PLANT DATA
PEAK LOAD 200. LUAD FACTOR .50
CUAL DATA
PKICE 53.80
UTILITY DATA
91L 1.0876 UIR 8.
GAS 4.62 DIR 10.
ELECTRIC .06042 DIR 6.
STEAM 10.3 DIR 6.
MANHOURS 30.
ATAU DIMORCOS
STARTUP YEAR 1987 MONTH 11
DISPLAY YEAR 1982 MONTH 11
COST INDEX 315.0
SCHEDULE 63.0 37.0
LIFE 25. SALVAGE O. DISCOUNT 10.
REFURMULATION DATA
CONSTRUCTION 14950 INDEX 216.8
STARTUP 1640 INUEX 216.8
CUAL 1540 RATE 30. + $/T
ELECTRIC 140 KATE .033 * $/KMH
GAS 10 RATE 2.37 * $/1000-SCF
DIL 10 KATE .4734 * $/GAL
STEAM 10 RATE 6.00 + $/1000-L8
LABOR 1135 KATE 20. * $/HK
OTHER ANNUAL 800 INDEX 216.8
COMPARISON DATA
BURN DIL
COMMERCIAL DATA
INFLATION 6.0
DEBT 30 INTEREST 11. KETURN 18.
THIRD PARTY LEASE LIFE 15.
INCOME TAX RATE 50. CREDIT 10
PROPERTY TAX PERCENT 2.
DEPRECIATION ACRS LIFE 5---
END CASE
```

EXAMPLR CASE 1

PLANT DATA

(1000-LB/HK)

PEAK LOAD LOAD FACTOK -

200.00

• 50

COAL DATA

PRICE (DISPLAY YEAR \$/TON) (PERCENT/YEAR)

DIFFERENTIAL INFLATION RATE

53.8

5.00

UTILITY DATA

	RATE	DIFFERENTIAL INFLATION RATE
	(DISPLAY YEAR DULLARS)	(PERCENT/YEAR)
ELECTRIC	\$.0604 /KWH	6.00
MANHOURS	\$ 30.0000 /HOUR	
GAS	\$ 4.6200 /1000-CU FT	10.00
STEAM	\$ 10.3000 /1000-LBS	6.00
OIL	\$ 1.0876 /GALLON	8.00

A-3

ECUNUNIC DATA

DISPLAY DATE - NOVEMBER 1982

STARTUP DATE - NUVERBER 1987

SCHEUULE (PEKCENT) - 63.00 37.00

DISPLAY YEAR CUST INUEX - 315.00

PLANT SALVAGE VALUE NAVY
LIFE (1000 REFURMU- DISCOUNT RATE
(YEARS) LATION DOLLARS) (PERCENT/YEAR)

00.01

COMERCIAL DATA: THIRD PARTY FINANCING

INFLATION MATE: 6.00 PERCENT PER YEAR

VEST FRACTION: 30.00 PERCENT

INTEREST RATE: 11.00 PERCENT PER YEAR RETURN ON EQUITY: 18.00 PERCENT PER YEAR

INCUME TAX MATE: 30.00 PERCENT

TAX CREDIT: 10.00 PERCENT PRUPERTY TAX AND INS.: 2.00 PERCENT OF TOTAL CAPITAL REGULRENENT

ACAS DEPRECIATION LIFE: 5 YEARS

LEASE LIFE: 15 YEARS

THE PARTY OF THE P

MEFURMULATION DATA

CUST ITER	CuST(1000 \$)	CUSI	ADJU	CUST ADJUSTMENT DENOMINATOR	ENON	INATO	
TUTAL CONSTRUCTION	14450.		16.80	216.8U (COST INDEX)	NOEX	3	
STARTUP	1640.	~	16.40	216.80 (COST INDEX)	NDEX	=	•
COAL	1540.	•	30.00	30.00 / TON			•
ELECTRIC	140.	•	03300	8 .03300 / KMH			
GAS	10.	•	2.37	2.37 / THOUSAND CUBTC FEET	AND	CUBIC	FEET
011	10.	•	.4734	S 1734 / THOUSAND GALLONS	AND	GALLON	2
STEAM	10.	•	9.00	6.00 / THUUSAND PULMDS	AND	POWO	
LABOR	1135.	•	20.00	20.00 / HOUR			
OTHER ANNUAL	\$000	~	16.80	216.80 (COST INDEX)	NOEX		

BASE CASE IS OIL-FIRED STEAN PLANT

CASE 1
EXAMPLK
9:
>
CJALR

SANTE CONTRACTOR DECREE DESCRIPTION OF SANTE SERVICE SANTES

		NAVY PRESENT VA	PRESENT VALUES IN DISPLAY YEAR DOLLARS	YEAR BOLLARS .	
		CUST (1000 \$)	UISCUUNT FACTOR	PRESENT VALUE (1000 S)	UNIT PRESENT VALUE ** (8/HILLION BTU)
CUNSTRUCT ION	1.786	4037.	. 7166	.0516	*2.
C ON STRUCT IUN	1981	13685.	.6515	4915.	14.
TOTAL CONSTRUCTION		21726.		14674	
STAKTUP	1981	2383.	. 6519	1892	10.
1487 - 2012					1
10801	•	1703.	5.4135	10064.	8.
OPERATING + MAINTENANCE MATEMIAL	ENANCE	7011	5.4135	6874.	16.
ELECTRICITY		.057	13.5400	347?	.15
CAS	1	. 19.	25.0000	• • • • • • • • • • • • • • • • • • • •	.0.
STEAM		17.	13.5466	231.	10.
011		23.	16.2930	+54.	20.
COAL		2762.	11.7108	32342.	- 10-1
TUTAL				70123.	3.20

* ALL COSTS AND PRESENT VALUES ARE REFERENCED TO THE DISPLAY DATE TF NOVERBER 1962 68 21900, BILLIUM BTUS OF HEAT ARE TRANSFERKED IN 25.0 YEARS OF UPCRATING LIFE

CUALK VI.O EXAMPLE CASE 1

		NAVY LEVEL 12ED	NAVY LEVELIZED COSTS IN DISPLAY YEAR DOLLARS •	TYEAR DOLLAR	• 1
		. CUST	LEVEL12ING FACTOR	LEVELI7ED COST (1000 %)	LEVELIZED COST **
. CONSTRUCTION	1986	.109	.1212	. 174.	11.11
CUNSTRUCT IUN	1981	13065.	.1102	1504.	1.72
TUTAL CONSTRUCTION		21722.		2487.	21722. 2487. 2.83

STARTUP 1987 - 1987	2383.	- 1102	. 267.	6.	
LABOP	1703.	1.0000	1701.	1.9	
OPERATING + NAINTENANCE NATERIAL	1162.	1.0000	1102.	1.33	
ELECTRICITY	256.	2.2908	587.	19.	•
GAS	19.	4.2276	•	8.	
STEAM	17.	2.2908		8.	
110	23.	3.0435	71.	8.	•
COAL	2762.	1.9404		6.24	! ! !
UTAL			11054.	13.54	

. ALL CUSTS ARE REFERENCED TO THE DISPLAY DATE OF NOVEMBER 1982

^{** 876.00} BILLIUN BTUS OF HEAT ARE THANSFERKED ANNUALLY

MAYY COST AND BENEFIT ANALYSIS (TMDUSANDS OF DISPLAY YEAR DOLLARS)

2363. 2363.	•	CUNSTRUCT COSTS	STARTUP CUST	UPERATING COSTS	UPERATING BENEFITS	10FERATING BENEFITS -COSTS)	VALUE DISCOUNT FACTOR	STAKTUP STAKTUP COSTS	OPERATIVG,	PV OF SAVINGS	:
2393. 6921. 13163. 66242994 10966. 4099. 7026594 7026994	İ	1037.					.117	5759.			
7150. 19163. 6442	-	345.	2383.	:			169.	10466:			
7150. 14190. 7020. 538 3894. 7251. 15210. 7086. 449 3374. 7262. 15210. 4744. 405 3165. 8152. 18953. 10070. 336 2972. 8153. 20402. 12044. 334 2672. 826. 14720. 276 2086. 14720. 276 2884. 9523. 27451. 16224. 225 2884. 10300. 31875. 21875. 1184 1893. 11047. 43050. 21875. 1184 1893. 11040. 37034. 22042. 117 1183. 11040. 37034. 22042. 117 1183. 11040. 37034. 40202. 0040 11040. 37044. 4202. 0040 11040. 38926. 28402. 117 1189. 1246. 67779. 52533. 0073 1189. 1256. 16564. 78890. 0013. 1051. 10564. 78897. 78226. 0040 10564. 78897. 78226. 0040 10566. 78897. 4202. 0040 10566. 78897. 4202. 0040 10567. 4202. 0040 10568. 78897. 62115. 0060 1057. 876. 816. 1071. 10586. 78898. 0051133. 10227. 93903. 978. 11899. 78100. 8141108 870 (FV / 21900. 8741108 870. 11899. 78100. 78100. 8741108 870 (FV / 21900. 8741108 870. 4141108 870. 112091. 11899. 7868 8141108 870 (FV / 21900. 8741108 870. 4141108 870. 112091. 11899. 7868 8141108 870 (FV / 21900. 8741108 870. 4141108 870. 112091. 11899. 78129 68 8141108 870 (FV / 21900. 8741108 870. 4141108 870. 112091. 11899. 781299 68 8141108 870. (FV / 21900. 8741108 870. 4141108 870. 112091. 11899. 78129 68 8141108 870. (FV / 21900. 8741108 870. 4141108 870. 4141108 870. 4141108 870. 41411108 870. 41411108 870. 4	•			6921.	13163.	6242.	.542	•	*004	3697.	
7351. 19216. 7866. 449 7362. 15309. 4774. 405 8053. 18953. 10870. 356 8053. 18953. 10870. 336 8053. 20402. 12044. 334 8053. 20402. 12044. 234 8053. 20402. 12044. 226 8053. 20402. 13244. 226 8053. 20503. 31675. 21575. 1184 8053. 20503. 31675. 21575. 1184 8053. 20503. 31675. 21666. 206 8053. 20500. 31675. 21666. 206 8053. 20500. 31675. 21666. 2172 8053. 20500. 31675. 2172 8053. 20603. 31675. 006 8053. 20603. 31675. 006 8053. 20603. 31675. 006 8053. 20605. 006 8053. 20605. 006 8053. 20605. 006 8053. 20605. 006 8053. 20605. 006 8053. 20605. 006 8053. 20605. 006 8053. 20605. 006 8053. 20605. 006 8053. 20605. 006 8053. 20605. 006 8053				7130.	14190	7020.	.538		3634	3780.	
7942. 16394. 4745. 4445 3374. 7446. 17610. 17610. 334 8353. 20402. 12044. 334 8457. 21467. 1324. 344 8457. 21467. 1324. 344 9252. 22464. 1324. 224 9252. 22464. 1324. 224 9252. 22464. 1770. 225 10400. 31875. 21975. 134 11095. 37924. 22949. 139 11544. 39926. 28402. 114 11545. 39926. 28402. 114 11549. 39926. 28402. 114 11549. 39926. 28402. 114 11549. 39936. 40312. 007 11549. 39996. 40312. 007 116900. 31899. 109 116900. 31899. 00112. 007 116900. 31899. 00112. 007 116900. 31899. 00112. 007 116900. 31899. 00113. 007 116900. 31899. 00113. 007 116900. 31899. 00113. 008 116900. 31899. 00113. 008 116900. 31899. 00113. 008 116900. 31899. 00113. 008 116900. 31899. 00113. 008 116900. 31899. 00113. 008 11899. 18998. 00113. 008 11899. 18998. 00113. 008 11899. 18998. 008 11899. 18998. 008 11899. 18998. 008 11899. 18998. 008 11899. 18998. 008 11899. 18998. 008 11899. 18998. 008 11899. 18998. 008 11899. 18998. 008 11899. 008 118				7351.	19216.	7866.	694.	:	3598.	3850.	
744. 17610. 978				7582.	16368.	1785.	.445		3374.	3909.	•
### 1989				7866.	17610.	4784.	•405		3166.	3958.	
### ### ### ### #### #################				•	- 18953.	10170.	.361		2772.	3997.	
8937. 21907. 13329304 8947. 23958. 14720276 89437. 23958. 14720276 8953. 27451. 16229228 8953. 27451. 1700028 10500. 31875. 21975189 11040. 37926. 23068172 11049. 37926. 23068172 11049. 37926. 23068172 11049. 37926. 23069137 11040. 37926. 23099139 112992. 4642239969107 112993. 46422. 37999107 112993. 46422. 37999107 112993. 46422. 37999107 112993. 46422. 37999107 112993. 46422. 37999107 112993. 46422. 37999107 112993. 46422. 37999107 112997. 75129008 112997. 75129008 112997. 75129009 112997. 77129009 112997. 77129009 112997. 77129009 112997. 771290. 87121000. 8712100. 8712100. 8712100. 8712100. 8712100. 8712100. 87121000. 8712100. 8712100. 8712100. 8712100. 8712100. 8712100. 87121000. 8712100. 8712100. 8712100. 8712100. 8712100. 8712100. 87121000. 8712100. 8712100. 8712100. 8712100. 8712100. 8712100. 87121000. 8712100. 8712100. 8712100. 8712100. 8712100. 8712100. 87121000. 8712100. 8712100. 8712100. 8712100. 8712100. 8712100. 87121000. 8712100. 8712100. 8712100. 8712100. 8712100. 8712100. 87121000. 8712100. 8712100. 87121000. 8712100. 87121000. 87121000. 87121000. 87121000. 87121000. 87121000. 87121000. 87121000. 87121000. 87121000. 87121000. 87121000. 87121000. 87121000. 87121000. 87121000. 87121000. 871210000. 87121000. 87121000. 871210000. 871				1353.	20402	12044.	.334		2792.	4028.	
9933. 27451. 18624251 .2324. 2324252 .25401. 18624251 .2524251 .2524251 .2524251 .2524252 .25401. 18624252 .2524 .2524 .2524 .2524 .2524 .2524 .2524 .2524 .16331944				8637.	21467.	13329.	*00.		2625.	4051.	
9553. 25481. 16224251 2324. 2324. 9553. 2751. 17668226 226 2188. 2188208 21957189 1944. 1944. 10500. 31875. 21575189 1944. 1944. 10500. 3187521575189 1944. 1933. 11090. 31073129 1954. 11574. 39926. 28402142 1172 11834. 11574. 39926. 28402142 1172 11834. 115744. 115744. 115744. 115744. 115744. 115744. 115744. 115744. 1157				.437.	23696.	147.00.	.276	•	2469.	4067	
9983. 27951. 17464228 .2062. 9993. 27978. 17646206 .2062. 10300. 31875. 21575189 .1944. 10567. 39936. 23664172 .1633. 11574. 39926. 28402172 .1833. 11577. 43090. 31073129 .1594. 11775. 43090. 31073129 .1366. 12995. 50063. 37109107 .1366. 12995. 50063. 37109107 .1366. 13983. 50063. 5779. 52933073 .1109. 1575. 570130. 740USAND (PV / 21900. 87LLTON'BTU) 5 11899. 740USAND (PV / 21900. 87LLTON'BTU) 6 11899. 740USAND (PV / 21900. 87LLTON'BTU) 7 11899. 740USAND (PV / 21900. 87LLTON'BTU)				4252.	25401.	16224.	167.		2324.	4076.	
10300. 31875. 21575189 10300. 31875. 21575189 11090. 31875. 21575189 11090. 34350. 23668172 11090. 37034. 25939196 11344. 39926. 289402144 11877. 430926. 31073117 1245. 90063. 37109107 1245. 90063. 37109107 1343. 53896. 40512097 1343. 53896. 40512097 1304. 62827. 46202088 11897. 75129007 11097. 110981171. 15246. 67779. 52533007 11098. 1109911098				9583.	27451.	17464.	927*	•	2100.	4080.	
10300. 31875. 21575189 1944. 10567. 34356. 23668172 1833. 11095. 37924. 22494126 1730. 11354. 39926. 28402142 1554. 11377. 43050. 31073129 1554. 12955. 50063. 37109107 1380. 13483. 53996. 40512097 1380. 13690. 58242. 44202098 1130. 14627. 62827. 44202098 1130. 1556. 67779. 5233073 1109. 15597. 73125. 75228066 1071. 15597. 73125. 5233073 1109. 1558. 270457. 721590. 62315060 16597. 870130. 744USAND (FV / 21900. 87LLTOW-BTU) 1558. 511894. 744USAND (FV / 21900. 87LLTOW-BTU) 1559. 511894. 744USAND (FV / 21900. 87LLTOW-BTU) 1550. 600 600 600 600 600 600 600 600 600 6	:	,		9933	29578	17646.			2902	4076.	
11099. 34396. 23668172 11099. 39734. 22939196 11524. 39924. 229402194 11524. 39924. 229402194 11295. 36924. 28402129 12995. 39924. 28402107 12495. 39994. 40512097 13483. 59242. 40202098 14027. 62627. 40202098 14027. 62627. 40202098 15246. 67779. 52533073 15246. 67779. 52533073 15246. 67779. 62315086 1997. 2343. 270497. 721590. 62315080 1054. 740USAND 1575 - \$ 70130. 740USAND 177				10300.	31075.	21575.	697.	-	1944	4071.	
11099. 37034. 25939196 11524. 11524. 39926. 28402142 1634. 11977. 43090. 31073129 1594. 1295. 50063. 37109107 1380. 13483. 53096. 40512007 1380. 13483. 53096. 40512007 1370. 13483. 53094. 40512008 1171. 15246. 67779. 52533073 1171. 15246. 67779. 52533073 1171. 15246. 67779. 62315006 2383. 270497. 721590. 62315006 2383. 270497. 721590. 623153. 16277. 53903. 2383. 270497. 721590. 623153. 16277. 53903. 2383. 270497. 721508 87U (FV / 21900. 87LLTOW 87U) 2383. 270497. 721508 87U (FV / 21900. 87LLTOW 87U) 2383. 270497. 721508 87U (FV / 21900. 87LLTOW 87U) 2383. 270497. 721508 87U (FV / 21900. 87LLTOW 87U) 2383. 270497. 721508 87U (FV / 21900. 87LLTOW 87U) 2383. 270497. 721508 87U (FV / 21900. 87LLTOW 87U) 2383. 270497. 721508 87U (FV / 21900. 87LLTOW 87U) 2383. 270497. 721508 87U (FV / 21900. 87LLTOW 87U) 2585. 270497. 721508 87U (FV / 21900. 87LLTOW 87U) 2585. 270497. 721508 87U (FV / 21900. 87LLTOW 87U) 2585. 270497. 721508 87U (FV / 21900. 87LLTOW 87U) 2585. 270497. 721508 87U (FV / 21900. 87LLTOW 87U) 2585. 270497. 721508 87U (FV / 21900. 87U (FV				10047.	34396.	23666.	.172		1033.	4060	
11544. 39926. 28402144 11977. 43090. 31073129 12953. 46422. 33969117 12955. 50063. 37109107 13463. 53996. 40512097 14027. 62827. 40202008 14027. 62827. 40200008 15546. 67779. 52533073 15546. 67779. 52533074 15546. 77829006 2383. 270497. 721590. 621153006 2383. 270497. 721590. 621133006 2383. 270497. 721590. 621133006 2383. 270497. 721508 87U (FV / 21900. 87LLTOW 87U) 2383. 270497. 74UUSAND (FV / 21900. 87LLTOW 87U) 2383. 270497. 74UUSAND (FV / 21900. 87LLTOW 87U) 2383. 2395. 2696R 71LLTOW 87U (FV / 21900. 87LLTOW 87U) 2383. 250 FER 71LLTOW 87U (FV / 21900. 87LLTOW 87U) 2383. 250 FER 71LLTOW 87U (FV / 21900. 87LLTOW 87U)			i :	11099.		25939.	- 1961		1730.	4045.	
11977. 43090. 31073129 1544. 12493. 46422. 37504117 1499. 12495. 50063. 37104107 1380. 13463. 53996. 40512097 1306. 14027. 62827. 40200008 1171. 1546. 67779. 52533073 1109. 15546. 67779. 52533007 15546. 77829. 62315006 997. 2363. 270497. 721590. 623153006 81277. 73129006 997. 8363. 270497. 721590. 623153006 81277. 73129006 997. 8363. 270497. 721508 87U (FV / 21900. 87LLTOW 87U) 84710 - 6.06 (FV 547165 / 67 876. 81LLTOW 87U) 84710 - 6.06 (FV 547165 / 67 1875)				11544.	39926.	20402	114	٠	1634	4027	
12493. 96422. 93969117 1499. 1299. 1299. 1299. 1299. 1300. 1343. 23496. 405120097 1300. 1300. 1300. 1300. 14027. 62827. 40200008 1171. 15246. 67779. 52533073 1109. 1171. 15897. 73129000 1171. 10564. 73829. 62315000 997. 2383. 270497. 72129. 62315000 997. 2383. 270497. 721590. 623153000 997. 2383. 270497. 721590. 623153. 16931. 16227. 93903. 997. 2383. 270497. 721908. 87111109. 87				11977.	43050.	31073.	.129		1544	4004	
1295. 50063. 37109107 1380. 1343. 53996. 40512097 1306. 14040. 58242. 44202098 11736. 1546. 67779. 52533073 1109. 15546. 67779. 52533073 1109. 15546. 77829. 62315060 997. 2343. 270457. 921590. 62315060 497. 2343. 270457. 921590. 651133. 16227. 53903. 997 5 70130. THUUSAND (PV / 21900. BTLLTOW BTU) - 5 11459. THUUSAND (PV / 21900. BTLLTOW BTU) - 5 11459. THUUSAND (PV / 21900. BTLLTOW BTU) - 6 0.06 (PV SAVINGS / 875. BILLION BTU (PV / SAVINGS / PV INVESTMENT)				12493		11969.	-111		1.53	3980	
13483. 53996. 40512097 14027. 62627. 44202086 1546. 67779. 52533073 15546. 67779. 52533073 15897. 73129. 5233073 15987. 73129. 62315066 2383. 270497. 421990. 651133. 16227. 53903. 97 2383. 270497. 421990. 651133. 16227. 53903. 97 2383. 270497. 721990. 651133. 16227. 53903. 97 2383. 270497. 721990. 651133. 16227. 53903. 97 2383. 270497. 421990. 651133. 16227. 53903. 97 2383. 270497. 421990. 651133. 16227. 53903. 97 2383. 270497. 421990. 671130. 674 / 21900. 6711100. 674 / 21900. 6711100. 674 / 21900. 67111100. 674 / 21900. 67111100. 674 / 21900. 67111100. 674 / 21900. 67111100. 674 / 21900. 67111100. 674 / 21900. 67111100. 674 / 21900. 67111100. 674 / 21900. 67111100. 674 / 21900. 67111100. 674 / 21900. 67111100. 674 / 21900. 67111100. 674 / 21900. 67111100. 674 / 21900. 67111100. 674 / 21900. 67111100. 674 / 21900. 67111100. 674 / 21900. 67111100. 674 / 21900. 67111100. 674 / 21900. 67111100. 674 / 21900. 67111100. 674 / 21900. 674 / 21900. 67111100. 674 / 21900. 67111100. 674 / 21900. 67111100. 674 / 21900. 67111100. 674 / 21900. 674 /				12455.	50063.	37104.	101.		1380.	3453.	
14027. 62627. 40202006 14027. 62627. 40200000 1371. 15246. 67779. 52533073 1109. 15547. 73129. 77228006 10564. 70849. 62315006 2363. 270457. 921590. 651133. 16227. 53903. 97. 2363. 270457. 921590. 651133. 16227. 53903. 97. 2363. 270457. 921590. 651133. 16227. 53903. 97. 2363. 270457. 921590. 651133. 16227. 53903. 97. 2363. 270457. 921590. 651130. 1697. 21900. 87LLTOW 87U) 2363. 270457. 921590. 651130. 1697. 876. 81LLTOW 87U 2363. 270457. 921590. 1697. 876. 81LLTOW 87U 2363. 270457. 876. 81LLTOW 87U (120611220 COST / 876. 81LLTOW 87U				13463.	53496.	40512.	160.		1306.	3923.	
14627. 62627. 46200080 1171. 15246. 67779. 52533073 1109. 1587. 73129. 52533073 10564. 78899. 62315086 2363. 270497. 421990. 621133. 16227. 53903. 97. 2363. 270497. 421990. 651133. 16227. 53903. 97. 1575 - 5 70130. 742USAND (PV / 21900. 87LLTOW 87U) - 5 113-94 FER MILLION 87U (PV1691) - 5 13-54 FER MILLION 87U (LEVEL12EU COST / 876. 81LLTON 87U - 6.08 (PV SAVINGS / PV INVESTMENT)				14040	30242	.202+	980		1236.	3191.	
15246. 67779. 52533073 1109. 15847. 73129. 57228086 16564. 78849. 62315086 2363. 270457. \$21590. 651133. 16227; 53903 1575 - \$ 70130. THUUSAND 1575 - \$ 70130. THUUSAND 177 - \$ 3.20-PER MILLION BTU (PV / 21900. BTLLTON BTU 1875 - \$ 11254. THUUSAND 1876 - \$ 13.54 PER MILLION BTU (LEVELIZED COST / 876. BILLION BTU 1876 - \$ 13.54 PER MILLION BTU (LEVELIZED COST / 876. BILLION BTU 1877 - \$ 13.54 PER MILLION BTU (LEVELIZED COST / 876. BILLION BTU				14027.	62827.	48200.	000	•	1171.	3056.	
19897. 73125. 57228086 1051. 16564. 78894. 62315060 997. 2363. 270457. 921590. 651133. 16227. 53903 1575 - \$ 70130. THUUSAND (PV / 21900. BTLLTOW BTU) - \$ 11854. THUUSAND (PV • .1641) - \$ 13.54 PER MILLION BTU (LEVELIZED COST / 876. BILLION BTU KATIO - 6.06				15246.	67779.	52533.	.073	•	1109.	3822.	
16564. 78899. 62315060 2383. 270497. ¥21990. 651133. 16277 53903. 977. 1575 - 5 70130. THUUSAND - 5 31259. FREE RICKTON BTU (FV V 21900. BTLLTON BTU) - 5 11259. FREE RICKTON BTU (FV V 1691) - 5 13.59 FREE RICKTON BTU (LEVELIZED COST / 876. BILLION BTU KATIO - 6.06				15097	3123	- 37276	1000		1601	3785.	
2383. 270457. V21590. 651133. 162277 53403. 75130. 7130. 7140USAND (PV 0 .1641) - 5 11824. 7HUUSAND (PV 0 .1641) - 5 11824. 7HUUSAND (PV 0 .1641) - 5 13.54 PER MILLION BTU (LEVEL12EU COST / 876. BILLION BTU (PV SAVINGS / PV INVESTMENT)				10584.	708¢4.	62315.	.060	,	497.	3747.	
	1	1722.	2303.	.70057.	421590.	651133.		192274	33903.	96739.	i i
- 5 11654 FER MILLION 670 (PV 0 .1641) - 5 11654 FER MILLION 670 (LEVELIZED COST / 876. BILLION 8710 (PV 5AVINGS / 9V INVESTMENT)		עב טב כו	• STSO	\$ 70130.	THUUSAND						
T = \$ 11459. THUUSANU T = \$ 13.54 PER MILLIUM BTU (LEVELIZEU COST / 876. BILLION KATIO = 6.08	T PRESEN	T VALUE	!	9.20	PER MILL'ID)			5	-	
ANTIO - 5 13.54 PER MILLION BTO (LEVELIZED COST / B76. BILLION KATIO - 6.06	ELT (FU C	150	•	\$ 11859.	THUUSAND				•	-	-
KATIO - 6.06	T LEVEL I	2ED CUS	•	13.54	1	5	VELIZED C	•	4 [LL 13N	101	
	I MCS/INV	EST MENT	KAT 10	0.0	•	Ē		/ PV INVEST	MENT		

+ PV DENOTES PRESENT VALUE

	4
٠.	
3	4
	1
•	J
	ä
	4
1	
1	Ē
è	ā
ì	ì
1	
4	•
_	
C	,
	•
•	٠
5	;
•	
•	٦,
2	ť
7 77 17	2
-	ž
•	,

COMSTRUCTION 1986 10755 1.1541 12411. 9PESEMT VALUE *** COMSTRUCTION 1987 18313. 1.0442 12411					944444444	
CONSTRUCTION 1980 10755 1-1594 12411. 12411. 19214. 19313 1-0492 19214. 19214. 19214. 19214. 19214. 1947 3189 1-0492 3344. 1947 3189 1-0492 3344. 1947 2278 9.5237 21699 16414. 1947 459 16.3028 7484. 42 25.0000 1097 10414. 42 42 25.0000 1097 10414. 42 42 42 42 42 42 42			CUST:	DI SCOUNT FACTUR	PRESENT VALUE (1000 \$)	UNIT PRESENT VALUE ++ (5/MILLION BTU)
CONSTRUCTION 1987 18313. 1.0442 19214. CONSTRUCTION 29066. 31627. 1 TARTUP 1987 3169. 1.0942 3394. 497 - 2012 497 - 2012 3394. 3394. 1 A60R 2276. 9.5237 21699. 1 FRATING. MAINTENANCE 1556. 9.5237 14614. 1 LFCTRICITY 459. 16.3028 7484. 7484. A5 42. 25.0000 1097. 1 TEAM 31. 16.3028 501. 1 IL 45. 20.0507 904. 3 Ual 9717. 14.7776 69704. 3	CONSTRUCTION	1986	10755.	1.1541	12411.	. 57
CONSTRUCTION 29066. 31627. 1 TARTUP 1987 3189. 1.0492 3344. 49.7 - 2012 A8.0R A8.0R LF.CTRICITY 459. 16.3028 7484. A5 42. 25.0000 1097. TEAM 31. 16.3028 >01. IL. 45. 20.0007 904. JOAL 47776 69704. 3	CONSTRUCTION	1987	16313.	1.0442	19214.	8
TARTUP 1967 3189. 1.0942 3344. 497 - 2012 2278. 9.5237 21699. ABOR 2278. 9.5237 21699. IFFRATING - MAINTENANCE 1556. 9.5237 14814. LFCTRICITY 459. 16.3028 7484. AS 42. 25.0000 1097. TEAM 31. 16.3028 >01. IL 45. 20.0507 904. OAL 4717. 14.7776 69704. 151131. 651131. 6	AL CONSTRUCTION		7,906		31627.	1. 44
497 - 2012 AB OR 2278. 9.5237 21699. 1F RATING + HAINTENANCE 1556. 9.5237 14814. ATEKIAL 1556. 9.5237 14814. LF CTRICITY 459. 16.3028 7844. AS 42. 25.0000 1094. TEAM 31. 16.3028 >01. IL 45. 20.0507 905. OAL 4717. 14.7776 69704. 151131. 6	STARTUP	1981	3189.	1.04%	3344.	•
ABOR PERATING + MAINTENANCE AATEKIAL LECTRICITY A59. Lb.3028 7484. 42. 25.0000 1097. TEAM 31. 16.3028 7484. 9.5237 14814. 1481	1497 - 2012					
PFRATING + MAINTENANCE 1556. 9.5237 14814. LFCTRICITY 459. 16.3028 7484. AS 42. 25.0000 1097. TEAM 31. 16.3028 >01. IL 45. 20.0507 905. UAL 4717. 14.7776 69704. 151131. 6	LABOR	,	2278.	9.5237	21694.	\$.
LFCTRICITY 459. 16.3028 7464. AS 42. 25.0000 1097. TEAM 31. 16.3028 501. IL 45. 20.0507 406. UAL 4717. 14.7776 69704.			1556.	4.5237	14814.	
42. 29.0000 1097. TEAM 31. 16.3028 501. IL 45. 20.00507 405. UAL 4717. 14.7776 69704.	ELFCTRICITY		•59.	16.3028	7484.	ě.
TEAM 31. 16.4028 >01. IL 45. 20.0507 905. UAL 4717. 14.7776 69704.	GAS		.24	25.0000	1097.	50 •-
1L 45. 20.0507 906. UAL 4717. 14.7776 69704.	STEAM		31.	16.3028	.104	• 05
OAL 4717. 14.7776 69704.	011		• • • •	700007	* 404	8.
151131.	COAL		4717.	14.7776		3. 18
					151131.	6. •

. 21400. BILLIUN BTUS UF MEAT ARE TRANSFERRED IN 25.0 YEARS UF OPCKATING LIFE

CASE
EXAMPLE
VI .0
CUALR

CONTRA ALCO		NAVY LEVEL 12EU	MAYY LEVELIZEU GUSTS IN STAKTUP YEAR UOLLARS	YEAR UGLLARS	•	
		Cus F	LEVELIZING FACTUR	LEVEL 17 EU COST (1000 %)	UNIT UNIT LEVELIZED COST **	
C DN STRUCT IUN	1986	10755.	.1212	1307.	1.49	
C UM STRUCT IUM	1947	18313.	7011.	2014.	2.30	
TUTAL CONSTRUCTION		2406d.		3,321.	3. 79	
STARTUP	. 1961	3184.	.1102	351.	66 *.	
1987 - 2012						
L A8 OR		2278.	1.0000	2279.	2.60	
OPERATING + MAIN MATERIAL	NTENANCE	1556.	1.0000	1554.	1.78	:
ELECTAICITY		454.	1.7118	784.	9.	
GAS		• 21	2.6290	117.		
STFAM		31.	1.7118	51.	8.	
011		• \$\$	2.1054	۶.	111.	
CUAL		•117.	1.5517	7317.	\$6. °	-
. TUTAL				15469.	1911	- -
+ ALL CUSTS AKE	KEFEKENCEU	MEFEMENCEU TO THE STARTUR DATE UF NOVEMBER	DATE OF NOVEMBE	1 1987		

.. d76.00 BILLIUN BTUS OF MEAT ARE THANSFERKED ANNUALLY

A-10

CUALK VI.O

EXAMPLK CASE 1

THIRD PARTY FINANCED/NAVY DPERATED VENTURE: INVESTOR CASH FLOMS DURING CONSTRUCTION PERIOD (THUDSANDS OF DULLARS)

	SOURCE	SOURCE UF FUNDS	USE OF	USE OF FUNDS	TOTAL	TAX	•	•	PRESENT VALUE	VA1 116
YEAR	DE8.1	DEBT EAULTY	CAP ITAL CUST	CAPITAL INTEREST CUST UN UEBT	SUUNCES AND USES	SAVINGS FRUM IUC DEUUCTION	TAV CREDITS	AFTER TAX EQUITY CASH FLOW	EULITY++ TUTAL PORTIUM INVESTME	ULITY++ TOTAL+ PORTION INVESTMENT
1986	3044.	7103.	10147.	•	0. 10147.	ô	1015.	. 6088	7184.	10563.
1961	6551.	15286.	41502.	335.	21637.	167.	1959.	13154.	13159.	19376.
I AL	TUT AL 9595.	22388.	31648.	335.	31963.	167.	.4.67	19247.	20343	29938.
~	KESENT VA	. PHESENT VALUE AT STAKT	NKTUP BASED	UN KETURN	UN EQUITY	TUP BASED UN RETURN UN EQUITY = 18.00 PERCENT PER YEAR	KCENT PER	YEAR		

PRESENT VALUE AT STARTUP BASED UN MEIGHTED COST UF CAPITAL - 15.40 PERCENT PER YEAR

CALCULATION OF TAX BASIS (THOUSANDS OF DULLARS)

	TAX	9639.	18944.	20583.
TAX CREDIT	TO TAX BASIS	507.	474.	1487.
	OF BT	•	335.	335.
PLANT INVESTMENT NCLUDING STARTUP)	TOTAL	10147.	21502.	31648.
PLANT INVESTMENT (INCLUDING STARTUP)	DEPECTABLE FORTIUM TOTAL	10147.	19589.	29735.
	YEAR	1986	1987	TUTAL

THIRD PARTY FINANCEU/NAVY UPERATED VENTURES
INVESTUR CASH FLUNS DURING OPERATING PETIDO
(THOUSANDS OF UOLLARS)

96739.	53 40 3.	OPEFATING COSTS)	-	421540.	270457. NU	15985. 8. THUUSANU	22270	46111. UF CUSTS	TAL 95303. PRESENT VALUE	TUTAL
3747.	997.	090	62315.	78849.	16564.	0	740.	0	0	707
3822	1109.	640	57278	73125	15447	• •	690	• •	• 6	2010
3458.	1171.	080	48270.	62827.	14627.	ò	•000	.	.	6007
3891.	1236.	.088	44272	58242	14040	: :	190	•	•	2008
3923.	1306:	260	40512	53996.	13483.		260.	.		2007
3980.	1459	111.	33949.	46422°	12453-	ċċ	2112	ô	• 6	\$007 \$007
+002	1544.	671.	31073.	43050	11977.	ó	•123	o	•	5007
4027.	1634.	-145	28472.	39926.	11524.	•	.135	°	•	7003
4045	1730.	156	22919	37034	11095	294	**1.	1981.	6354	7007
1040	1 844	621	23658	34196	10487	0 0 0 F	941	2100.	6.354	0007
4078.	2062.	.208	19646.	29578	4433.	467	961.	2359.	6354.	6441
+080+	2188.	822*	17648.	27451.	9583	544.	.218	2501.	6354	1998
4076.	2324.	157.	10279.	25461.	4256	•	452.	2651.	6354.	1441
4067.	2 469.	.276	14770	23656	8457	740	.263	2810	6354	1996
4028.	2792.	+ 60 E	13324	20402	6355	1000	615.	3128.	6354	477
3497.	2472.	.368	10870	18953.	8083	1173.	.350	3347.	6354	8667
3958.	3166.	\$04.	9744.	17610.	7826.	1368.	.386	3548.	6354.	1992
3409	3374.	, , , , , , , , , , , , , , , , , , ,	6745	16366	7282	1747	*7**	3761.	6354	1661
3760.	3 G 3 G 4	DE C	,0,0,	14150.	7150	.8917	516.	•677	6354	5951
3697.	*660	596.	6242.	13163.	6421.	2528.	.504	4479.	6354.	1988
PV OF SAVINGS	OPERATING COSTS	AND DPERA-	-	UPERATING BENEFITS	OPEKA FING COSTS	COST	FUK	CUNSTANT	CUPRENT	YEAR
	P 4 0F	PV FACTOR FOR SAVINGS	SAVÌMGS (UPER.			P	PV* FACTOR	E CUST	LEASE	
			VENTUR": Pertuu	UPERATEU UPERATING BULLARS)	FINANCEU/NAVY FLUMS UURING THOUSANDS OF	CASH	THIRU			
							R CASE 1	EXAMPLR CASE	٧١٠٥	COALK VI.O

* PV DENUTES PRESENT VALUE. * ** PRESENT VALUES ARE REFERÊNCED TO THE DISPLAY YEAK. *** LEVELIZED CUSTS ARE ÎN CONSTANT DISPLAY YEAR DULLAKS.

-
CASE
EXAMPLE
41.0
COALK

The state of the s

A. Kelek

SUMMARY

NAVY FINANCED/NAVY UPERATEU VENTURE VS. THIRO PARTY FINANCED/NAVY UPERATED VENTURE

PRESENT VALUE REFERENCED PRESENT VALUE REFERENCED
TO DISPLAY VEAR
(11/1962)

MAYY FINANCEU/MAYY OPERATEU VENTURE:

PRESENT VALUE
UNIT PRESENT VALUE
LEVELIZED CUST
UNIT LEVELIZED COST
SAVINGS/INVESTMENT MATIU
DISCUUNTED PAYBACK PERIUD

\$ 70130. THOUSAND \$ 3.20 PER MILLITM BTU \$ 11859. THOUSAND \$ 13.54 PER MILLITM BTU 6.08

PER MILLION STUTHOUSAND

6.90

\$151145. THOUSAND

19.12 PER MILLION-BTU

4.3 YEARS

THIRD PARTY FINANCED/MAYY UPERATED VENTURES

MAYY OPERATUR
PRESENT VALUE
UNIT PRESENT VALUE
LEVELIZED CUST
UNIT LEVELIZED CUST
SAVINGS/INVESTMENT RATIU
DISCOUNTED PAYBACK PERIOU

PRIVATE INVESTOR LEVELIZEU MEVENUE (LEASE) LEASE LIFE

S 6354. THUUSAND PER YEAR

YEARS

18.05 PEK MILLION 6TU

... 5.98 PER RILLION BTU

PER HILLIM STU

THOUSAND

13.49 PER MILLIAN BTU

11616. THUUSAND

3.19

\$150624. THOUSAND

15915. THUUSAND

Table A-2

CASE 2 - THIRD PARTY FINANCED/THIRD PARTY OPERATED (ALL PRIVATE) VENTURE, ACRS DEPRECIATION, COMPARISON WITH BURNING OIL

INPUT DATA LISTING

```
EXAMPLE CASE 2
PLANT DATA
PEAK LOAD 200. LUAD FACTUR -.50
COAL DATA
PRICE 53.80 DIR 5.
UTILITY DATA
OIL 1.0876 DIR 8.
GAS 4.62 DIR 10.
ELECTRIC .C6042 DIR 6.
STEAM 10.3 DIR 6.
MANHOURS 30.
ECONOMIC DATA
STARTUP YEAR 1987 MONTH 11
DISPLAY YEAR 1982 MONTH 11
CUST INDEX 315.0
SCHEDULE 63.0 37.0
LIFE 25. SALVAGE O. DISCOUNT 10.
REFORMULATION DATA
CONSTRUCTION 14950 INUEX 216.8
STARTUP 1640 INDEX 216.8
COAL 1540 RATE 30. # $/T
ELECTRIC 140 RATE .033 * $/KWH
GAS 10 RATE 2.37 * $/1000-5CF
OIL 10
       RATE .4734 * $/GAL
STEAM 10 RATE 6.00 + $/1000-LB
LABOR 1135 RATE 20. * $/HK-
OTHER ANNUAL BOO INDEX 216.8
COMPARISON DATA
BURN GIL
COMMERCIAL DATA
INFLATION 6.0
DEBT 30 INTEREST 11. KETURN 1d.
PRIVATE
INCUME TAX RATE 50. CREDIT 10
PROPERTY TAX PERCENT 2.
DEPRECIATION ACRS LIFE 5-
END CASE
```

ECONUMIC DATA

DISPLAY DATE - NUVENBER 1982

STARTUP DATE - NUVERBER 1947

SCMEDULE IPERCENTS - 63.00 37.00

DISPLAY YEAR CUST INDEX - 315.00

PLANT SALVAGE VALUE NAVY ... LIFE 11000 NEFURRU- UISCUUNT RATE ... LATION UOLLAKS) (PERCENT/YEAR)

75.0 0. 10.00

COMMERCIAL DATA: PRIVATE VENTURE

2.00 PERCENT UF TOTAL CAPITAL REGUIREMENT 6.00 PERCENT PER YEAR 11.00 PERCENT PER YEAR 18.00 PERCENT PER YEAR 30.00 PERCENT SO.00 PERCENT 10.00 PERCENT S YEARS ACKS DEPRECIATION LIFE: PROPERTY TAX AND INS.: RETURN UN EQUITY: INCOME TAX KATES INFLATION MATE: DEBT FRACTION: INTEREST RATE: TAX CREUITS

CUALM VI.O EXAMPLM CASE 2

PRIVATE VENTURE CASH FLOWS DUKING CONSTRUCTION PERIOD (THOUSANDS OF DOLLARS)

VAL UE	TOTAL* NVE STRENT	10563.	14376.	29936.
PRESENT VALUE	FQUITY TOTAL PORTION INVESTMENT	7184.	13159.	.69607
AET GV TAK	EQUITY CASH FLOW	6068.	13159.	19247.
•	TAY CREDITS	1015.	1989.	2974.
FAX	FRUM IDC DEDUCTION	ó	167.	167.
FOTAL SOURCES	AND	10147.	345. 21037.	31963.
FUNDS	COST ON DEBT	ċ	335.	935.
USE OF FUNDS	CAP ITAL COST	10147.	21502.	31648.
SOURCE OF FUNDS	EUUITY	7103.	15286.	22388.
SOURCE OF FUNDS	Den T	3044	6551.	TUTAL 9545.
	YEAR	1986	1961	TUTAL

PRESENT VALUE AT STARTUP BASED ON RETURN UN EULITY = 18.00 PERCENT PER YEAR

** PRESENT VALUE AT STARTUP BASED UN MEIGHTED COST OF CAPITAL * 15.40 PERCENT PEA YEAR

CALCULATION OF TAX BASIS (THOUSANDS OF DOLLARS)

~ ' 🕱	CINCLUDING STARTUP) CINCLUDING STARTUP) DEPRELIABLE PORTIUN TOTAL	> i	INTEREST UN UEBT	TAX CREDIT ADJUSTHENT TU TAX BASIS	TAX
•	10147.	10147.	o	507.	4634.
•	145 89.	21502.	135.	.474	18949.
	29735.	31044.	335.	1487.	28583.

PRIVATE VENTURE CASM FLOWS DURING OPERATING PERTOD (THOUSANDS OF DULLARY)

TEAR PENSES BENEFITS SA LING A LING BENSES BENEFITS SA LING BENSES BENEFITS SA LING BENSES BE	UPER- ATING SAVINGS INTEREST 8800- 10584- 12661- 15076- 15076- 15076-	1AX	AFTEM-TAX							
10564. 1936.3. 10564. 1936.3. 11484. 22.066. 12448. 25.156. 13613. 37.24. 16197. 37.336. 17690. 42607. 19338. 42632. 23165. 63.977. 25384. 72.402. 27836. 82.701. 30547. 94478. 35665. 123.92.			MET	FIER-1AX EUCITY	3	INTEREST + TAX	AF TER-TAX NET		INTEREST + TAX	AFTEK-TAX FOULTY
10564. 19363. 11484. 220663. 12498. 22158. 13613. 28689. 14842. 32724. 16197. 42689. 19338. 42632. 23165. 63497. 25384. 72402. 27836. 82701. 3546. 12352. 40539. 140973.		CIATION	FL0#	FLOA	PENSES	CIATION	FLOW	* DEB SERVICE	CIATION	FLON
11484. 22088. 12448. 25158. 13613. 28889. 16147. 32724. 16147. 32324. 21157. 5551. 23165. 6347. 25384. 72402. 25384. 72402. 25384. 72402. 25636. 82701. 33546. 10744? 33546. 123352.		1287.	7071.	5932.	9114.	4610.	\$ 101.	9416.	4526.	5027.
12448. 25158. 13613. 28689. 136147. 32724. 16147. 37336. 17590. 48632. 23165. 63447. 23165. 63447. 25384. 72402. 25836. 82701. 33546. 107447. 33546. 123352.		6288.	8424	7620.	A549.	5460.	5670.	9006	5268.	5616.
13613. 28689. 14842. 32724. 16147. 37339. 17690. 42607. 19348. 5567. 23165. 63447. 25384. 72402. 25384. 72402. 25384. 10747. 30547. 94478. 33546. 107447.	•	6002.	9890.	8710.	720P	4521.	5327.	6300	4284.	. 5301.
14842. 32724. 10147. 37330. 17690. 42607. 19338. 5384. 72402. 25384. 72402. 27830. 82701. 30547. 94478. 33540. 123352. 40539. 140473. 1		6002	11052.	.7166	7544.	3694.	5125.	7609.	3624.	5113.
16197. 37330. 17690. 42607. 19336. 48632. 21157. 59521. 23165. 63397. 27836. 86701. 30547. 94478. 33546. 107947. 38859. 140973. 1	•	6002.	12448.	11309.	7097.	3354.	5452.	6486.	3066.	4543.
17690. 42607. 19338. 48632. 21157. 55521. 23165. 63397. 25384. 72402. 27836. 82701. 30547. 94478. 33546. 107947. 3685. 123552.	•	•	11069.	9929.	2894	412.	4567.	. 2249	370.	3678.
19346. 48632. 21127. 55521. 23165. 63497. 25344. 72402. 27636. 82701. 30547. 94478. 39546. 107447. 36865. 123352.	•	•	12949.	11610.	4297.	150.	4610.	5911.	308.	3707.
21157. 55521. 23165. 63497. 25344. 72402. 27836. 82701. 30547. 94478. 33546. 107447. 36865. 123352.	•	•	15130.	13940.	\$ 939.	.962	4647.	5448.	257.	3722.
23165. 63497. 25344. 72402. 27636. 82701. 30547. 94478. 33546. 107947. 36865. 123352.	•	•	17655.	16516.	1607.	291.	4079.	5027.	213.	3724.
25344. 72402. 27836. 82701. 30547. 94478. 33546. 107947. 36865. 123352. 40539. 140973. 16	•	•	20578.	19434.	5297.	211.	4705.	4644.	177.	3714.
27636. 82701. 30547. 94478. 33540. 107947. 36805. 123352. 40539. 140973. 10	17019. 901.	•	23960.	42821.	5008.	178.	4727.	4295.	146.	3695.
30547. 94478. 3354e. 107947. 3685. 123352. 40539. 140973. 1	34669. 879.	•0	27870.	26731.	4738.	149.	4744	3976.	120.	3668.
33546. 107947. 3889. 123352. 40539. 140473. 1.	63931. 846.	ċ	32388.	31249.	4486.	124.	4757.	3685.	.0	3634.
36865. 123352. 40539. 140973. 1	74401. 814.	•	37607.	36468.	4251.	103.	4705.	3418.	80.	3594.
40539. 140973. 1	86487. 778.	•	43633.	42493.	4031.	1 .68	4770.	3174.	65.	3549.
•	00434. 738.	ċ	50586.	.7.44.	1624.	70.	4772.	2950.	52.	3500.
•	:		:	•	•	-				
•	• •	• •	•	• •	• •	• •	• •	• •	• (• •
•	•		•	•	•	•	•	•	• •	• •
2012 97911. 470830. 372	372919. 113.	•	186516.	185377.	2448.		4663.	1581.	2	2958.
TOTAL 907835. 3626432. 2658598.	18884.	20503.	1353034.	1324552.	173470.	24289.	12 5460.	104605.	22813.	95058.

	3 D D D
DULLARSI	= \$133407. TMOUSANU = \$ 6411 PER MILLIUN BTU = \$ 16274. TMOUSAND = \$ 18.58 PER MILLIUN BTU +.67 = Z.8 YEARS
YEAR	3407. 6411 6274. 18.58 7.67 2.8
ISTARTUP	101
EQUITY	PRESENT VALUE UNIT PRESENT VALUE LEVELIZED COST **** UNIT LEVELIZED COST SAVINGS/INVESTMENT RATIO ** SIMPLE PAYBACK PERIUD *** DISCOUNTED PAYBACK PERIOD***
ETURN ON	IT VALUE RESENT V ZED CJST EVEL IZED SZINVEST PAYBACK INTED PAY
USING	PRESEN UNIT P UNIT L SAVING SIMPLE UISCOU
AMALYSIS USING RETURN ON EQUITY (STARTUP YEAR DULLARS)	RINIM'S PRESENT VALUE = \$1. REGULOE - LEVELIZED CTST **********************************
AMALYSIS USING BEIGHTED COST OF CAPITAL (STARTUP YEAR BULLARS) AMALYSIS USING RETURN ON EQUITY (STARTUP YEAR BULLARS)	- \$159057. THOUSAND - \$ 7.26 PER MILLIUM BTU - \$ 16691. THOUSAND - \$ 19.00 PER MILLION BTU - 4.19 - 3.4 YEARS
(START	7.26 1.26 1.0641. 19.00 4.14
CAP 1 TAL	11 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
COST OF	VALUE VALUE TO CUS T THENT RA THENT RA VARACK PE
AMALYSIS USING WEIGHTED COST OF CAPITAL (ST	MENT MUM PRESENT VALUE KEVENUE UNIT PRESENT VALUE KEUURE- LEVELIZED CUST **** MENTS UNIT LEVELIZED CUST SAVINGS/INVESTMENT RATIU ** SIMPLE PAYBACK PERIOD *** DISCUUNTEU PAYBACK PERIOD ****
USING	2323000
S. I	HINT NUM KE VY NUE KE VU IR E- HENT S

PRESENT VALUE AT STARTUP USING BEIGHTED COST OF CAPITAL = 15.40 PEFCENT PER YEAR
 PRESENT VALUE AT STARTUP USING RETMEN ON EQUITY = 18.00 PERCENT PE? YEAR
 PRESENT FOR YEAR
 PRESENT DOLLARS MULTIPLY BY
 PROPERTIZED CUSTS ARE IN CONSTANT STARTUP DULLARS. TO CONVERT TO CURPENT DULLARS MULTIPLY BY

PRIVATE VENTURE MINIMUM REVENUE REGULALMENTS UISCUUNTING MITH MEIGHTED CAST UF CAPITAL

(COSTS IN NUVERBER 1987 DOLLARS)

	COST	DISCOUNT	VALUE	PRESENT VALUE +	LE VELI ZING	LEVELTZED CUST ++	
CAP 17AL	0001	7 AC 10K	2000	CAVAILLION BTU	FACTOR	6 0001	(S/AILLION BTU)
AMMUAL RETURN TO INVESTORS	.1462	6.1164	14316.	. 69.	1.0000	2341.	19.7
AMUAL COMPONATE INCOME TAXES	.745	6.1164	2701.	.12	1.0000	**5	.50
. AMUL PRUPERTY TAXES. INSUKANCE	287.	6.1164	1756.	30°	1.0000	.782	. 55.
TUTAL CAPITAL CHANGES	3069.		10772.	. 98.	:	3069.	3.50
OPERATING (1987 - 2012)						;	
LABOR	1703.	6.1164	10413.	•	1.0000	1703.	1.94
OPERATING + MAINTENANCE MATERIAL	1162.	6.1104	7109.	.32	1.0000	1162.	1.33
ELECTRICITY	236.	14.6643	3759.	.17	2.3975	.619.	. 10
GAS	14.	27.8883	544.	•05	4.5596		•10
STEAM	17.	14.6643	727	10.	2.3975	.1.	•0•
	23.	20.1042	162.	70.	3.2869	76.	
COAL	2764.	12.5810	34745.	1.59	5.0569	5661.	9.0
TOTAL OPENATING			\$ 7284.	2.62		9366.	10.69
TUTAL LIFE CYCLE CUST			76056.	3.47		12435.	14.20

UNIT PRESENT VALUE BASED ON 21400. BILLIUN BTU HEAT TRANSFERRED UVER 75.0 YEARS UF LIFE

LEVELIZED CUST IN CUNSTANT DISPLAY BULLARS. TO CONVENT TO CURRENT DULLIRS MULTIPLY BY

^{***} CUNSTANT BOLLAK UNIT LEVELIZED COST BASED ON 876.00 BILLION BTU HEAT TRANSFERRED PER YEAR

PRIVATE VENTURE MINIMUM REVEAUE REGULKEMENTS ULSCUUNTING ALTH RETURN ON EQUITY

THE PERSONAL PROPERTY IN THE PROPERTY AND ADDRESS OF THE PERSONS ASSESSED TO THE PERSONS ASSESSED TO THE PERSON NAMED TO THE P

(COSTS IN MOVEMBER 1987 DULLARS)

	CAP 17AL	EQUITY CUST (1000 \$)	DI SCOUNT FACTOR	PRESENT VALUE (1000 S)	PRESENT VALUE +	LE VELI 21NG FACTUR	LEVELIZED CUST 00 (1000 8)	LEVELIZED CUST ***
	AMUAL RETURN TO EQUITY MOLDERS	1847.	4.0132	6892.	14.	1.3000	1847.	2.11
	AMMUAL DEST SERVICE	266.	4.6132	2723.	•12	1.3000	206.	\$9.
	A WILL CORPORATE INCOME TAXES	341.	4.8132	1643.	9 0.	1.3000	341.	39
	AMOUAL PRUPERTY TAXES, INSURANCE	E 297.	4.8132	1431.	. 10.	1.3000	.162	
TUTAL	TUTAL CAPITAL CHARGES	.3052.		14084.			3052.	3.48
	QPEPATING (1987 - 2012)							
A- 2	LABUR	1703.	4.0132	8194.	.37	1.0000	1703.	1.94
0	OPERATING + MAINTENANCE MATERIAL	L 1162.	4.8132	5595.	•26	1.0000	1162.	
	ELECTRICITY	256.	1110111	2822.	.13	2.2877	586.	.67
	GAS	14.	20.2416	395.	• 02	4.2054	. 28	•0•
	STEAM	17.	1110.11	189.	.01	2.2877	39.	10:
	011	23.	14.8424	341.	•05	3.0637	71.	•0•
	CUAL	.7027	1.5257	.40507.	1.20	1.9791	5466.	6.24
TUTAL	TUTAL OPERATING			43844.	2.00		9109.	10.40
TUIAL	TUIAL LIFE CYCLE COST		`.	58532.	2.67		12161.	13.88
	-		ı				-	

UNII PRESENI VALUE BASEU UN 21900. BILLIUN BIU MEAT TRANSFERKED UVER 25.0 YEARS OF LIPE

LEVELIZED CUST IN CONSTANT DISPLAY BULLAKS. TU CUNVERT TO CURRENT DOLLARS MULTIPLY BY

^{***} CONSTANT DULLAR UNIT LEVELIZED COST BASED ON 876.00 BILLION BTO HEAT TRANSFERRED PER TEAK

	3	•
,		1
•	ŧ,	ì
4	8	
1	_	
•	3	•
	₫	١
- 7	٩	
	2	ı
	_	ì
	-	۰
	٩	
•	d	,
	•	•
	-	ı
;	ď	•
•		
3	ď	
	•	ì
=	z	1
2.00.7	4	١
c	:	t
•	1	١
_	_	

SUMMARY

NAVY FINANCEU/NAVY UPERATED VENTUÄE VS. THIRD PARTY FINANCED/THIRD PARTY UPERATED (ALL PRIVATE) VENTURE

PRESENT VALUE BEBRBBLIE	TO STARTUP VEAL		
PRESENT VALUE REFERENCED	TO DISPLAY YEA	(11/1/482)	

NAVY FINANCED/NAVY UPERATED VENTURES

\$191149. THOUSAND
\$ 70130. THQUSAND \$ 3.20 PER MILLIN BTU \$ 11659. THUUSAND \$ 13.54 PER MILLIN BTU 6.08
PRESENT VALUE UNIT PRESENT VALUE LEVELIZED COST UNIT LEVELIZED COST SAVINGS/INVESTRENT RATIU DISCOUNTED PAYBACK PERIUD

THIRD PARTY FINANCED/THIRD PARTY UPERATED LALL PRIVATES VENTURES

AFTFK-TAX NET CASH FLOH ANALYSIS DISCOUNTING HITH HEIGHTED COST OF CAPITAL

LION BTU > 7.26 PER MILLION BTU D S 10641. THOUSAND LINN BTU S 10641. THOUSAND HID S 19.00 PER MILLION BTU +19 S.4 YEARS 4.8 YEARS	133907. THUUSAND
\$ 76056. THQUSAND \$ 3.47 PEK MILLINM BTU \$ 12435. THQUSAND \$ 14.20 PEK MILLINM BTU \$ 14.20 PEK MILLINM BTU \$ 14.8	\$ 50532. THQUSAND
PRESENT VALUE OF MINIMUM NEVENUE NEUDINEMENT UNIT PRESENT VALUE LEVELIZED CUST (KEAL %) UNIT LEVELIZED COST SAVINGS/INVESTMENT RATIU SIMPLE PAYBACK PERIOD DISCOUNTED PAYBACK PERIOD AFTR-TAK EUUITY CASM FLUM ANALYSIS OISCOUNTING MITH KETUKN UN EUUITY	PRESENT VALUE OF MINIMUM REVENUE REGULACHENT S 20532. THOUSAND Unit present value

UNIT PRESENT VALUE UNIT PRESENT VALUE LEVELIZED COST (MEAL S) UNIT LEVELIZED COST (MEAL S) S 12161. THOUSAND S NZIGLIZED COST S AVINGS/INVESTMENT KATIU SIMPLE PAYBACK PEKIUD DISCUUNTEU PAYBACK PEKIUD 2.0. YEARS

Table A-3

CASE 3 - THIRD PARTY FINANCED/NAVY OPERATED VENTURE, SOYD DEPRECIATION, COMPARISON WITH BURNING OIL

INPUT DATA LISTING

EXAMPLE CASE 3 PLANT DATA PEAK LOAD 200. LUAD FACTOR .50 CUAL DATA PKICE 53.80 DIR 5. UTILITY DATA DIR 8. 9IL 1.0876 GAS 4.62 DIR 10. ELECTRIC .06042 DIK 6. STEAM 10.3 DIR 6. MANHOURS SC. ECONOMIC DATA STARTUP YEAR 1987 MONTH 11 DISPLAY YEAR 1982 MONTH 11 COST INDEX 315.0 SCHEDULE 63.0 37.0 LIFE 25. SALVAGE O. DISCOUNT 10. REFURMULATION DATA CONSTRUCTION 14950 INDEX 216.8 STARTUP 1640 INDEX 216.8 CUAL 1540 RATE 30. + \$/T FLECTRIC 140 RATE .033 * \$/KWH 5AS 10 RATE 2.37 + \$/1000-50F 9IL 10 HATE .4734 * \$/GAL STEAP 10 RATE 6.00 * \$/1000-LB LABOR 1135 RATE 20. + S/HR OTHER ANNUAL BOO INDEX 216.8 CUMPARISUN DATA SURN OIL CUMMERCIAL DATA INFLATION 6.0 DEST 30 INTEREST 11. KETUKN 18. THIRD PARTY LEASE LIFE 15. INCUME TAX RATE 50. CREDIT 10 PROPERTY TAX PERCENT 2. DEPRECIATION SOYD LIFE 25 END CASE

E AAMPLK CASE 3

ECUNUAL DATA

DISPLAY DATE - NUVEMBER 1982

STARTUP DATE - NUVENBER 1947

63.00 SCHEDULE (PERCENT) -

315.00 DISPLAY YEAR CUST INDEX -

UISCUUNT KATE (PERCENI/YEAK) 10.00 SALVAGE VALUE (1000 REFURNU-LATION UULLAKS) (YEARS) 25.0

COMMERCIAL DATA: THIRD PARTY FINANCING

2.00 PERCENT UF TOTAL CAPITAL REQUIREMENT 6.00 PERCENT PER YEAR 11.00 PENCENT PER YEAR 18.00 PENCENT PER YEAR 30.00 PERCENT 50.00 PERCENT 10.00 PERCENT 25 YEARS SUYU DEPRECIATION LIFE: PROPERTY TAX AND INS.: RETURN ON EQUITY: INCOME TAX RATES INFLATION RATE: DEBT FRACTION: INTEREST RATES TAX CREDIT:

15 YEARS

LEASE LIFE:

CUALK VI.O

EXAMPLH CASE 3

INLEG PARTY FINANCED/NAVY UPERATED VENTURE: INVESTOR CASH FLUAS DURING CONSTRUCTION "ERIUD ITHUUSANDS OF DULLARS)

	SOUNCE	SAUKCE OF FUNDS	USE OF	USE OF FUNDS	TOTAL	TAX			PRESENT	PRESENT VALUE
VEAR	0687	DEBT EWITY	CAP ITAL COST	CAPITAL INTEREST COST ON DEST	ANU USES	FROM TOC DEDUCTION	TAY CRED'TS	EQUITY CASH FLOW	FULITY TUTAL PORTION INVESTME	FULITY** TUTAL* PORTION INVESTMENT
1986	3044.	7103.	10147.	ċ	0. 10147.	ė	1015.	6 088.	7164.	7164. 10563.
1967	6551.	15280.	71507.	335.	21837.	167.	1949.	13159.	13159.	19376.
TUTAL	IUTAL 9595.	.22308.	31646.	335.	31963.	167.	2974.	2974. 19247.	20343.	29938.

PRESENT VALUE AT STARTUF BASEU UN RETURN UN ELLITY - 16.00 PERCENT PER YEAR

PRESENT VALUE AT STARTUP BASED ON WEIGHTED COST OF CAPITAL . 15.90 PERCENT PER YEAR

CALCULATION OF TAX BASIS
(THOUSANDS OF DOLLARS)

10147. 19923. 30070. ------BASIS TAX CKEDIT **AUJUSTHENT** • TO TAX INTEREST 335. 335. ė ON UEBT I INCLUDING STAKTUP) 10147. 21502. 31648. TUTAL PLANT INVESTMENT DE PRECIABLE PORTION 10147. 19589, 24735. TUTAL 1986 YEAR 1987

CUALK VI.O EX

Section 1 | Comment of the section o

EXAMPLE CASE 3

THIRD PARTY FIVANCED/NAVY UPERATED VENTHE: INVESTOR CASH FLUAS JUAING OPERATING PEPIDD (TMUUSANDS OF DOLLARS)

:		:			į									:			
ALUE (PV) TUP 30 PCT	AMDUNT	3631.	3033	2532	2112.	1 760.	1466	1770	1014	842	900	577.	477.	393	323.	597	20343.
PRESENT VA AT STAK	FACTOR	. 847	.718	609	-516	.437	370	314	266	. 225	191	.162	.137	.116	**0	• 90•	
AF TEK-TAX	CASH FLOW	4285.	4223	4160.	4045	4077	3958	3886.	3611.	3733	3651.	3566	3476.	3381.	3261.	3175.	56707.
	TAXES	,250.	7312.	1375.	2441.	2508	2577.	7649.	2724.	,802.	1884.	2970.	1059.	1154.	1254.	1360.	+1321.
	TAXABLE	4501.	4624.	4751.	1881	5016.	5155.	\$249.	2449	5605.	5766.	5939.	6119.	6308.	6508	.0779	82642.
	DEPREC- IATION	.6162	7571.	2128.	.9602	1443.	1450.	1758.	1005.	1573.	1460.	1388.	1295.	1203.	1110.	.0101	.184+2
BEFUKE-TAX	CASH FLOR	6935	6545.	0535.	6535.	6535.	0535.	6539.	6535.	6535.	6935.	6535.	6535.	6535.	6535.	6535.	40024.
RV ICE	TOTAL	1334.	1334.	1334.	1334.	1334.	1334.	1334.	1334.	1334.	1334.	1334.	1334.	1334.	1334.	1334.	20015.
UEBI SE	POKTION	1055.	1025.	.16	453.	911.	409	813.	755.	.769	621.	542.	425.	354.	251.	137.	10450.
LEVEL 17EU ATNI RUA	REJUIRENENT	7870.	7870.	7870.	7870.	7870.	7870.	7870.	7870.	7870.	7670.	7870.	7870.	7870.	7470.	7870.	118043.
	YEAR	1988	1980	1440	1441	1442	1943	1444	1445	9661	1447	1448	6441	2009	1007	7007	TOTAL

THIRD PARTY FINANCED/NAVY UPERATED VENTOR'S NAVY CASH FLUMS DURING UPERATING PERIOD (THOUSANDS UF DULLARS)

	PV OF SAVINGS	3697.	3780.	3850.	3404	3958.	3997.	402 d.	4091.	4067.	4076.	.4080	4078.	4071.	4060	4045.	4027.	4005	3480.	3953.	- 3923.	3891.	3858.	3822.	3785.	3747.	98739.	-		
30	ERAT	4049.	3839.	3548.	3374.	3166.	2472.	2742.	2629	2469.	2324.	2 188.	2062.	1444	1833.	1730.	1634.	1944.	1459.	1 380.	1306.	1236.	1171.	1109.	1051.	997.	53 40 3.		(UT8 NCI	PY LEASE!
PV FACTOR	SAVING COSTS	265.	.538	78+·	C++•	.405	.368	.334	.304	9270	167*	228	•208	.189		.156	241.	129	.117	101	160.	990	080.	. 073	•00•	090•		NG-COSTS) N 87J)	876. BILL 13N	LEASE) Edeu Fur Avings = 10tal PV
SAVIVES	BENEFITS - COSTS)	6242.	7000	7840.	8745.	9744.	10870.	12049.	13379.	14770.	16279.	17848.	19646.	21575.	236A G.	25919.	28472.	31073.	33469.	37104.	40512.	44272.	48570.	92513.	57.27.8.	62315.	651113.	PLUS OPEPATING COSTS	0 COST /	7 % Z % Z % Z % Z % Z % Z % Z % Z % Z %
	UPEKAT ING BENEFITS	13163.	14190.	15216.	16364.	17610.	16953.	70407	21967.	.36962	25481.	27451.	29576.	31475.	34356.	37034.	34426.	43050.	40462.	\$0063	93446	58242.	02827.	67779.	73125.	78499.	421540.	(PV / 21900.	EL 12	CUMULATIVE
	OPERATING CUSTS	6.421.	7130.	7351.	7382.	7826.	8083.	8353.	. 8637.	6437.	9252.	4583.	9933.	10300.	10687.	11095.	11524.	. 11477.	12453.	12455.	13463.	14040	14027.	15246.	15497.	16584.	270457.	SAND AILLION STU	MIELIUN BTU	
3	356	3132.	2686.	2303.	1475.	1694.	1455.	1246.	1064.	¥17.	766.		578.	+40.	429.	305.	;	•	•	•	ċ	•	°	•	ċ	•	19744.	THUU	PER	YEARS
WEST WAS		.564	.913	194.	.424	.346	.350	.319	.240	.263	462.	.218	.198	.180	104	.149	.135	. 123	.112	•102	260.	*90*	•076	. 004	•063	.057		* \$ 73702. * \$ 3.37	- 9 14.23	7·c = 00
CUST	CUNSTANT	5548.	5234.	*ABA*	4050.	4364	4140.	3411.	3690.	3481.	3264.	3048.	2475.	2757.	2601.	2454.	•	ó	ċ	ċ	•	•	ċ	ċ	ċ	0	57113.	OF COSTS	CUSI	PERI
LEASE	CURKENT DULLAKS	7870.	7870.	7870.	7870.	7870.	7870.	7870.	7870.	7470.	7870.	7870.	7670.	7870.	7870.	7870.	•	•	ċ	ċ	ċ	•	•	•	•	•0	118043.	PRESENT VALUE OF COSTS UMIT PRESENT VALUE FREE FIRE	UNIT LEVELIZED CUST	SAVINGS/INVESTRENT UISCOUNTED PAYAACK
	YEAR	1 988	1989	0661	1441	1992	1443	1441	1445	9461	1447	1440	1474	2000	2001	2002	7003	\$007	5002	9007	2007	2008	6007	0107	1107	2102	TUTAL	PR ES UN IT	115	24 VI 01 SC

PV DENDTES PRESENT VALUE.
 PRESENT VALUES ARE REFFRENCED TO THE DISPLAY YEAK.
 PPF LIZED COSTS ARE IN CONSTANT DISPLAY YEAK DULLARS.

Ç	>
	•
•	•
_	
3	£
	J
3	t
C	Ş
ξ	•

EXAMPLE CASE 3

NAVY FINANCED/NAVY OPEKATED VENTUKE VS. THIRD PARTY FINANCED/NAVY UPERATED VENTUKE

SUMMARY:

PRESENT VALUE REFERENCED TU STARTUP YEAK PRESENT VALUE REFEPENCED TO DISPLAY YEAP

(11/1982)

(11/11987)

5.90 PER MILLION BTU 15973. THOUSAND 18.12 PER MILLION BTU \$151145. THOUSAND 4.3 YEAKS 90.0 3.20 PER MILLINN BTU 13.54 PER MILLION BTU UNASUCHT THUUSAND 11859. \$ 70130. MANY FINANCED/NAVY UPERATED VENTURES PRESENT VALUE
UNIT PRESENT VALUE
LEVELIZED COST
UNIT LEVELIZED CUST
SAVINGS/INVESTMENT KATEO DISCOUNTED PAYBACK PERIUD

THIRD PAKTY FINANCED/NAVY UPERATED VENTURE:

PER MILLITH STU 14.23 PER MILLION BTU 12463. THUUSAND THOUSAND 3.37 UNIT LEVELIZED CUST SAVINGS/INVESTMENT MATIU DISCOUNTED PAYBACK PEMIOD PRFSENT VALUE UNIT PRESENT VALUE LEVEL 12EU CUST MAY UPERATUR

PRIVATE INVESTOR LEVELIZED REVENUE (LEASE) LEASE LIFE

7870. THUUSAND PER YEAR 15 YEARS

5.2 YEARS

\$5.4

PEK MILLION BTU

SISUSA4. THOUSAND

19.34 PER MILLION BTU

Table A-4

CASE 4 - THIRD PARTY FINANCED/NAVY OPERATED VENTURE, ACRS DEPRECIATION, COMPARISON WITH WITH BURNING GAS-

INPUT DATA LISTING

FXAMPLK CASE 4 PLANT DATA PEAK LUAD 200. LUAD FACTOR .50 COAL DATA PRICE 53.80 UIR 5. UTILITY DATA OIL 1.0876 DIK 8. GAS 4.62 DIR 10. ELECTRIC .06042 DIR 6. STEAM 10.3 DIR 6. MANHOURS JU. ECONOMIC DATA STARTUP YEAR 1987 MONTH 11 DISPLAY YEAR 1982 MONTH 11 COST INDEX 315.0 SCHEDULE 63.0 37.0 LIFE 25. SALVAGE O. UISCOUNT 10. REFURMULATION DATA CONSTRUCTION 14950 INDEX 216.8 STARTUP 1640 INUEX 216.8 COAL 1540 RATE 30. * 5/T ELECTRIC 140 RATE .033 # \$/KWH RATE 2.37 * \$/1000-SCF SAS 10 RATE .4734 * \$/GAL 9IL 10 STEAM 10 KATE 6.00 * \$/1000-LB LABOR 1135 KATE 20. * \$/HK OTHER ANNUAL 800 INVEX 216.8 COMPARISON DATA BURN GAS COMMERCIAL DATA INFLATION 6.0 INTEREST 11. RETURN 1d. DEST 30 THIRD PARTY LEASE LIFE 15. INCUME TAX RATE 50. CREDIT 10 PROPERTY TAX PERCENT 2. DEPRECIATION ACRS LIFE 5 END JOB

ECUNUMIC DATA

DISPLAY DATE - NUVERBER 1982

STANTUP DATE - NUVERBER 1937

SCHEDULE (PERCENT) - 63.00 37.00

DISPLAY YEAR CUST INDEX - 315.00

SALVAGE VALUE NATY (1000 REFURNO DISCUUNI RATE LATIUN UULLARS) (PERCENT/YEAR)

LIFE

00.01

25.0

COMMERCIAL DATA: THIRD PARTY FINANCING

2.00 PERCENT UF TUTAL CAPITAL REGUIREMENT 11.00 PERCENT PER YEAR 16.00 PERCENT PER YEAR 6.00 PERCENT PER YEAR 30.00 PERCENT SU.00 PERCENT 10.00 PERCENT 5 YEARS ACRS DEPRECIATION LIFE: PRUPERTY TAX AND INS.: RETURN ON EQUITY: INCOME TAX RATE: INFLATION KATE: DEBT FRACTION: INTEREST RATE: TAX CREDIT:

15 YEAKS

LEASE LIFE:

NAVY LUST AND DENEFIT ANALYSIS (THUUSANDS OF DISPLAY YEAR DULLARS)

YEAR	CONSTRUCT CUSTS	STAATUP CUST	OPEKATING CUSTS		SAVINGS CUPERATING BENEFITS -CUSTS)	PRESENT VALUE DISCOUNT FACTUR	CANSTRUCT • STAKTUP COSTS:	PV OF OPEKAT ING, CUST S	PY UF SAVINGS	
9971	8037.					.717	5754.	# # #		
1981	13085.	7383	•	. (.169.	10468		•	
227			6441.	4206.	4262	244.		* 604	1531.	
7971			7130.	10371.	3241.	35.0		3634.	1745.	
1440			7351.	11323.	3472.	794.	•	3598.	1444.	
1441			7582.	12369.	4767.	.445		3374	2130.	
2661			7826.	13520.	5644.	. 405	•	3166	2303.	
1443			6003.	14785.	.2070	.368	•	2472.	2965	
1994			8353.	10176.	7823.	.334		2792	2615.	
1945			8637.	17705.	4008	.304		2625.	4756.	
1446			8937.	19367.	10420.	.276	•	2464	2887.	:
1441			9252.	21236.	11764.	.251		2324.	3010.	
1998			9583.	23269.	1.1066.	977.		.188.	3125.	
1994			9933.	25505.	15573.	207	•	2062	3233	į
2000			10300	27.464.	17664.	.184		1444	3333.	
1007			10687.	30067.	19760.	.172		1033.	3428.	
7007			11095.	33641.	.45546.	.150	•	1730.	3516.	1
2003			11524.	36910.	25346.	711.		1634	3599.	
5004			11977.	40505	28529.	.129	•	1544.	3677.	
2002			12453.	44459.	32006.	.117	:	1459.	3730.	!
9007			12955.	48607.	35653.	101.		1380.	3619.	
7007			13483.	53584.	40106.	.047		130 e.	. 4884	
2008			14040	56646.	.10R++	200.		1236.	3449.	
6002			14027.	64631.	>0000	090		1171.	+005	
2010			15246.	70440	55745.	.073		110%	4056.	
2011			15697.	77985	62087.	990		1021	+107.	•
2012			16584.	45677.	69043.	090.		497.	4154:	-
TOTAL	.22712	2383.	270457.	869825.	544368.		16227.	\$3403	79013.	
PRESENT	PRESENT VALUE OF L	י פוצטי	. \$ 70130.	TAGUSAND						
2 115	_		. \$ 3.20	PER MILLIUM	N BTU (PV	•	21900. BTLLIUM BTU)	5		
LE VELI		-	- \$ 1185¥.	TACUSAND	> ÷	•				
UNIT LI	UNIT LEVELIZED GUS	-	- \$ 13.54	PER MILLION	ьТU	EL 1 2E	•	NCI 7	410)	
SAVING			•	•	2	V SAVINGS /		reento		
or scuti	DI SCUUNTED PAYBACK	. PERIOU,	7.5	YEAKS	2			VEEDED FOR COMULATIVE	VE	
						PV SAVINGS	- PV INVESTRENT			

THIRU PARTY FINANCED/NAVY UPERATED VENTURES NAVY CASH FLOWS DUKING OPERATING PEKIUD (THOUSANDS OF DOLLARS)

SAVINGS 1944. 2303. 3884 3945. 1745. 2405. 2615. 2756. 2887. 3010. 3125. 3233. 3333. 1428 3516. 3544. 3677. 3750. 4005 4056-4107. 4154. 3619. PV OF AND OPERA- UPERATING 3598. 3166. FUR SAVINGS PV UF COSTS 3 474. 2792. 454. 306 1109. 2324. 514. 051. 876. STLL 13N BTU! 3 839. 2 472. 2469. 2062. 833. 1634. PV FACTOR TING COSTS .073 .405 152 2229 189 .129 1117 .097 595 .538 .142 101 980. (LEASE PLUS OPE•ATING COSTS) (PY / 21900. BILLIUN BTU) IPV SAVINGS / PV LEASE) ING. UF YEARS NEEDEU FUR BENEFITS 2545. 3972. 7873. SAVIVES 5694. 6772. (UPCK. - COSTS) 3241. 11944. .0440. 32006. 15573. 55745. 599356 7644 19940. 22546. 2>346. 28579. 35853. 44877. 50073. 52047. 10176. 64043 CLEVELIZED COST / 11323. 16176. LEASE UPERATING UPERATING COST COSTS BENEFITS 95ub. 85677. 10371. 41236. 27964. 44459. 64631. 469825. 4369. 13520. 14785. 19387 25505. 30667. 33641. 36410. 40505. 48807. 53589. 58648. 70440. 77985. 23269, 2 .151. 13.44 PER MILLIUN'BTU 7130. 470457. 826. 8433. 6721. 6043. 4252. 9563. 4433. 0300 13463. 14627. 286 0687 11524. 12453, 15246. 8937 11095 11477 2455 14040 15447 16584 3.19 PEK MILLION LIBIB. THUUSAND \$ 69886. THUUSAND 863. 2528. 1368. 1006. 635. 544. 1.5 YEARS 1595. 740. 343. 2168. 1860. PV F FACTUR .319 11.44 1115 .386 457 .263 218 .513 1407 198 180 .123 102 240 180 9/0 LEASE DISCOUNTED PAYBACK PERIOU SAVINGS/INVESTMENT RATIO DOLLARS 3548. 2810. 2651. 3761. 3347. 2226. 1981. PRESENT VALUE OF COSTS CONSTANT 3900. 3158. 2979. 2354. 40111. 4479. 4225. 2100. LEASE CUST UNIT LEVELIZED CUST UNIT PRESENT VALUE LEVELIZED COST CURRENT DULLARS 6354. 435% 6354. 6.454. 6354. 6354. 6334. 6354. 6 35 4. 6354. 45303. 6354. 6354. 6354 6354. 1984 2040 1992 1443 1444 1436 1997 279 6441 2000 2003 1007 2002 900 7007 2008 6007 2010 1661 2002 S

CUMULATIVE PV SAVINGS = TOTAL PV LEASE!

PV DENUTES PRESENT VALUE.
 PRESENT VALUES ARE REFERENCEU TO THE DISPLAY YEAR.
 LEVELIZED COSTS ARE IN CONSTANT DISPLAY YEAR DULLARS.

COALR V1.0

EXAMPLE CASE 4

SUMMAKY

NAVY FINANCED/NAVY UPERATED VENTURE VS. THIRD PARTY FINANCED/NAVY UPERATED VENTURE

PRESENT VALUE REFEVENCED TO DISPLAY YEA! (11/1942)

PRESENT VALUE REFERENCED TO STANTOP YEAR (11/1987)

MAYY FINANCED/MAYY UPERATED VENTURES

LEVELIZED COST UNIT LEVELIZED COST SAVINGS/INVESTRENT MATIO DISCOUNTED PAYBACK PERIUD PRESENT VALUE Unit Present value

19.12 PER MILLION BTU PEK MILLION BTO 15970. THUUSAND THOUSAND 9.90 \$151145. 3.20 PER MILLINN BTU 13.54 PER MILLIAN THUUSANU THOUSAND 11859. 70130.

YEARS

THIRD PARTY FINANCED/NAVY UPERATED VENTURES

MAYY OPERATUR

SAVINGS/INVESTMENT KATIO DISCUUNTED PAYBACK PERIUD UNIT LEVELIZED COST PRESENT VALUE UNIT PRESENT VALUE LEVELIZED CUST

PRIVATE INVESTUR LEVELIZED MEVENUE (LEASE) LEASE LIFE

6354: THUUSAND PER YEAR 15 YEARS

7.5' YEANS

19.35 PER MILLION STU

THOUSAND THOUS AND

PER MILLION BTU

\$156524.

THOUSAND PER MILLION BTU-THOUSAND

13.49 PER MILLINN

A-32

Appendix B

PROCEDURE TO CONVERGE TO A DESIRED OUTPUT QUANTITY BY A METHOD OF SUCCESSIVE TRIALS

One purpose of COALR is to permit determination of input assumptions that are consistent with calculated quantities published in reports or included in proposals to the Navy. Since the calculations in COALR proceed from input to calculated quantities, and are not reversible, it is necessary to find the correct values of input variables by a search procedure of some kind. This appendix presents a search procedure that is rapidly converging and easy to use. The procedure is a method of successive trials.

The method of successive trials can be carried out for either of the following two choices for the input variables sought:

- o Scalar procedure: only a single input variable is to be adjusted by the trial procedure.
- Vector procedure: two or more input variables are to be adjusted at the same time by the trial procedure.

In the scalar procedure, the method of successive trials consists of the following steps:

- 1. Select the input variable whose value will be sought by the trial procedure. Denote this variable by x.
- 2. Define a trial index i, and initialize it to i = 1.
- 3. Prepare the input for a first trial case, which includes a first trial value, x_i , for variable x. The first value x_i is arbitrary.
- 4. Make a run for the trial case with input containing x_i , and record the resulting value y_i of the calculated quantity.

- 5. Select an amount Δx by which variable x will be changed in the next trial. The Δx selected is arbitrary.
- 6. Prepare an input for a next trial case in which x has the value $x_{i+1} = x_i + \Delta x$.
- 7. Make a run for the trial case with input containing x_{i+1} , and record the resulting value y_{i+1} of the calculated quantity.
- 8. Decide whether y_{i+1} is sufficiently close to the desired value y^0 of the calculated quantity. If it is, terminate the procedure.
- 9. If y_{i+1} is not sufficiently close to y^0 ; calculate a next change in x given by

$$\Delta x = -(y_{i+1} - y^0)/s$$

where s is the slope

Salar Comment of the
$$s = (y_{i+1} - y_i)/(x_{i+1} - x_i)$$

10. Increase the trial index i by one and return to Step 6.

The scalar extrapolation process is described pictorially in Figure B-1. The procedure above is simply one of linear interpolation or extrapolation.

In the vector procedure, the method of successive trials consists of the following steps:

- Select the set of n input variables whose values will be sought by the trial procedure. Denote these variables by a¹, a²,...,aⁿ, and consider them components of a vector A in an n-dimensional vector space.
- 2. Define a trial index i, and initialize it to i = 1.
- 3. Prepare the input for a first trial case which includes first trial values $\mathbf{a_i}^j$ of the components of vector A. These trial components make up first trial vector $\mathbf{A_i}$.
- 4. Make a run for the trial case, and record the value y; of the calculated quantity.

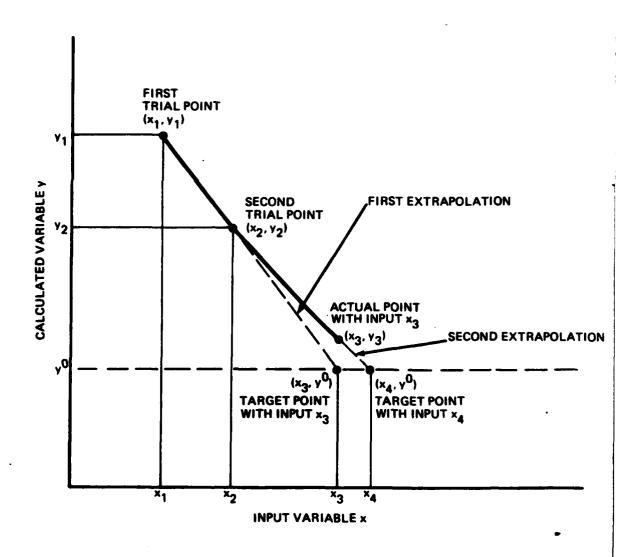


Figure B-1 METHOD OF SUCCESSIVE TRIALS FOR A SCALAR INPUT VARIABLE

- 5. Select a change vector B with components b¹,b²,...,bⁿ. This vector defines the direction of the changes in A by the trial procedure. It may be convenient to select b¹ equal to one, so that b², ..., bⁿ define the ratio of the changes in variables a²,...,aⁿ to the change in variable a¹.
- 6. Introduce a trial parameter x, which defines the changed value of vector A through the equation

$$A = A_0 + xB$$

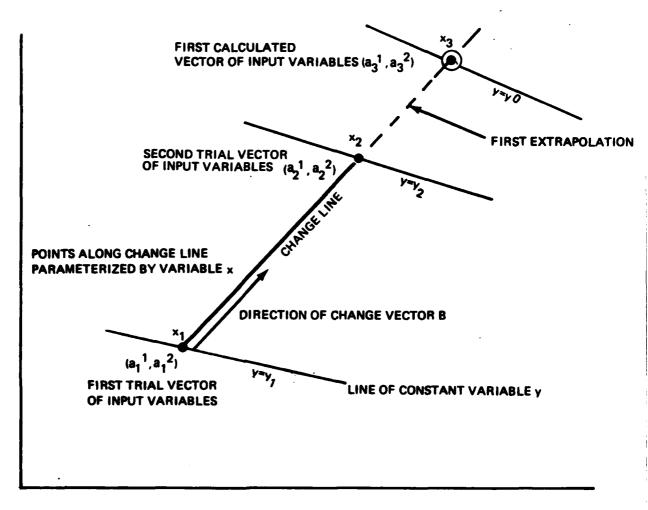
where Ao is any initial choice of vector A.

- 7. Select an amount Δx by which variable x will be changed in the next trial. The Δx selected is arbitrary.
- 8. Enter Step 6 of the scalar procedure.

The vector extrapolation process is described pictorially in Figure B-2.

Table B-1 indicates which input variables will increase a calculated quantity and which will decrease it. This information is useful in selecting the first two trial cases to start the procedure. If the vector procedure is selected, it is generally desirable to choose a change vector in which either all the components increase the calculated quantity or all the components decrease the calculated quantity. Otherwise, the effects of changes in components may have opposing effects which cancel.

Figure B-3 is a calculation form that will guide the reader through the procedure. Table B-2 presents a sample calculation utilizing the scalar procedure. Table B-3 presents a sample calculation utilizing the vector procedure.



INPUT VARIABLE a1

Figure B-2 METHOD OF SUCCESSIVE TRIALS FOR A 2- COMPONENT VECTOR OF INPUT VARIABLES

Table B-1

DIRECTION OF CHANGE IN CALCULATED QUANTITIES PRODUCED BY INCREASES IN INPUT VARIABLES

Imput Variable Increased	Unit Levelized Cost (constant \$)	Savings/ Investment Ratio	Payback Period
Reformulation Year Construction Cost	+(1)	_(2)	+
Reformulation Year Startup Cost	+	-	+
Reformulation Year Annual Coal Cost	+	-	+
Reformulation Year Annual Electricity Cost	. •	•	+
Reformulation Year Annual Gas Cost	+	-	+
Reformulation Year Annual Oil Cost	+	-	+
Reformulation Year Annual Auxiliary Steam Cost	+	-	•
Reformulation Year Annual Labor Cost	+	• .	+
Reformulation Year Other Annual Costs	. •	-	•
Reformulation Year Cost Index	-	+	-
Reformulation Year Coal Rate	-	+	
Reformulation Year Electricity Rate	•	•	-
Reformulation Year Gas Rate	-	+ ~	-
Reformulation Year Oil Rate	-	•	-
Reformulation Year Auxiliary Steam Rate	-	•	
Reformulation Year Labor Rate	-	+	-
Display Year Coal Price	•	•	+
Display Year Electricity Price	+	-	+ •
Display Year Auxiliary Oil Rate	+	-	•
Display Year Auxiliary Gas Rate	+	-	+
Display Year Auxiliary Steam Rate	+	-	•
Display Year Labor Rate	+	-	•
Display Year Coal DIR (3)	+	-	+

^{(1) + =} calculated quantity increases.

^{(2) -=} calculated quantity decreases.

⁽³⁾ DIR = differential inflation rate.

⁽⁴⁾ M/A = not applicable.

^{(5) ? =} calculated quantity could increase or decrease.

Table B-1 (Cont'd)

Input Variable Increased	Unit Levelized Cost (constant \$)	Savings/ Investment Ratio	Payback Period
Display Year Electricity DIR	•	-	+
Display Year Auxiliary Oil DIR	+	-	+
Display Year Auxiliary Gas DIR	+	-	+
Display Year Auxiliary Steam DIR	+	-	+
Display Year Alternative Oil Rate	N/A ⁽⁴⁾	+	-
Display Year Alternative Gas Rate	N/A	+	-
Display Year Alternative Oil DIR	N/A	+	-
Display Year Alternative Gas DIR	N/A	+	-
Display Year Cost Index	+	-	•
Peak Load	-	?(5)	?
Load Factor	-	?	?
Plant Life	-	?	?
Salvage Value	-	+	-
Nevy Constant Dollar Discount Rate	+	-	+
Number of Construction Years	+	-	+
Years from Display to Startup Years	?	?	?
Inflation Rate	-	+	-
Fraction of Investment that is Debt	-	+	-
Rate of Interest on Debt	•	-	+
Rate of Return on Equity	+	-	+
Duration of Third Party Lease	?	?	? •
Income Tax Rate	+	-	+
Income Tax Credit	+	-	•
Property Tax Percent	•	-	+
Depreciation Life	•	-	•

⁽¹⁾ (2) + = calculated quantity increases.

^{- =} calculated quantity decreases.

⁽³⁾ DIR = differential inflation rate.

⁽⁴⁾ N/A = not applicable.

^{? =} calculated quantity could increase or decrease. (5)

Figure B-3

FORM FOR PREPARING SUCCESSIVE TRIALS COMPUTATION OF INDEPENDENT VARIABLE X TO GIVE TARGET DEPENDENT VARIABLE Y

Title of Computation					_
Name of Independent Variable x					_
Name of Dependent Variable y				·····	
Target Value of y		 			_
Tabulation of Results of Succesive Trials					
Trial Number i	1	2	3	4	
Trial Input xi: Units:					_
Calculated yi: Units:			·		_
Target Value of y ⁰			· 		
Error in $y = \Delta y_i^0 = (y_i - y^0)$					_
Computation of Next Trial Value of x					
Correction Number j		1	2	3	
Change in y Between Trials, Δy_j	******				
Change in x Between Trials, Δx_j				P	
Slope, $\Delta_{y_j}/\Delta_{x_j}$		·		,	
Mext Change in y Should Equal Minus the Error in y: $\Delta y = -\Delta y_i^0$				•	
Next Change in Input x: $\Delta x = \Delta y/(\Delta y_j/\Delta x_j)$					
Next Input: $x_{i+1} = x_i + \Delta x$					

Table B-2

SCALAR PROCEDURE SAMPLE PROBLEM

Background

A third party approaches the Navy offering to finance the coal-use plant in the example in Table A-1. The third party will compute its annual lease charge to the Navy using the financial assumptions of that example.

Problem: Determine the Navy discount rate equivalent to the financing costs of the third party.

Approach: Find the Navy discount rate that gives identical values for the following:

- The present value of the total capital requirement in a Navy financed/Navy operated venture (from Report 3)
- The cumulative present value of lease payments in a third party financed/Navy operated venture (from Report 8)

Method: Calculate the ratio of the total capital present value to the cumulative lease present value. Find by successive trials the discount rate that makes the ratio equal to 1.0.

Starting Data

Trial Number i	1	2	3	4
Trial Input x: Units: %/yr	10	9	9.733	
Calculated y: Units: Dimensionless	1.015	0.958	0.9998	
Calculation of y				
Calculated Navy Present Values from Output:				
PV of Investment: Units: \$1000	16227	16852	16391	
PV of Lease: Units: \$1000	15985	17582	16393	
Calculated y = Ratio (Dimensionless)	1.015	0.958	0.9998	

Table B-2 (Cont'd)

Cumputation Form Calculations

RESERVED STREET STREETS CONTROL OF THE STREET CONTROL O

Title of Computation	Samp	le Scalar I	Problem	
Name of Independent Variable x	Nevy	Discount	Rate	
Name of Dependent Variable y	Ratio	of PV's:	Investme	nt/Lease
Target Value of y	1.0			
Tabulation of Results of Successive Trials				
Trial Number i	1	2	3	4
Trial Input xi: Units: %/yr	10	9	9.733	
Calculated yi: Units: Dimensionless	1.0151	0.9585	0.9998	
Target Value of y ⁰	1.0000	1.0000	1.0000	
Error in $y = \Delta y_i^0 = (y_i - y^0)$	0.0151	-0.0415	-0.0002	
Computation of Next Trial Value of x				
Correction Number j	1	ı :	2	3
Change in y Between Trials, Δy_j	-0.0	0566		
Change in x Between Trials, ∆xj	-1			
Slope, Δy _j /.Δx _j	0.6	0566		
Mext Change in y Should Equal Minus the Error in y: $\Delta y = -\Delta y_1^0$	0.0	0415		
Hext Change in Input x: $\Delta x = \Delta y/(\Delta y_j/\Delta x_j)$		7333		
Mext Input: $x_{i+1} = x_i + \Delta x$	9.1	7333		

Table B-3

VECTOR PROCEDURE SAMPLE PROBLEM

Background

The Navy seeks a third party to finance the coal-use plant in the example in Table A-1. The Navy is prepared to pay commercial financing costs if they have an equivalent Navy discount rate no higher than 10 percent.

<u>Problem</u>: Determine how much higher the example interest and return rates may be raised to give an equivalent Navy discount rate of 10 percent.

Approach: Find the amount to be added to both the return rate and the interest rate that gives identical values of the following:

- o The present value of the total capital requirement in a Navy financed/Navy operated venture when the Navy discount rate is 10 percent (from Report 3)
- o The cumulative present value of the lease payments in a third party financed/Navy operated venture, when calculated with a Navy discount rate of 10 percent (from Report 8)

Method: Calculate the ratio of the total capital present value to the cumulative lease present value. Find by successive trials the amount added to both interest and return rates to make the ratio equal to 1.0. Use as x the weighted cost of capital formed from the interest and return rates.

Starting Data

Trial Number i	1	2	3	4
Trial Input x: Units: %/yr	15.9	16.9	16.174	
Calculated y: Units: Dimensionless	1.015	0.9559	0.9996	
Calculation of Input x				
Interest Units: %/yr	18	19	18.274	
Return Units: Z/yr	11	12	11.274	
x, Weighted Cost of Capital (1)	15.9	16.9	16.174	

(1) When a given amount is added to both the interest and the return, the weighted cost of capital also increases by that amount.

Table B-3 (Cont'd)

(Ca 1	cu	14	ti	on	of	y

Calcu	lat	ed N	levy	Pre	:561	nt	
Value	:s f	TOE	Out	put	whe	en	
Nevv	Di e	CONT	r R	at e	ie	107	/wr

PV of Investment:	Units:	\$1000	16227	16227	16227
PV of Lease:	Units:	\$1000	15985	16905	16234
Calculated v = Rat	io (Dime	nsionless)	1.015	0.9599	0.9996

Cumputation Form Calculations

Title of Computation	Sample Vector Problem			
Name of Independent Variable x	Weighted Cost of Capital			
Name of Dependent Variable y	Ratio of PV's: Investment/Lease			
Target Value of y	1.0			

Tabulation of Results of Successive Trials

Trial Number i	1	2	3	4
Trial Input xi: Units: %/yr	15.90	16.90	16.174	
Calculated yi: Units: Dimensionless	1.0151	0.9599	0.9996	******
Target Value of y ⁰	1.0000	1.0000	1.0000	
Error in $y = \Delta y_i^0 = (y_i - y^0)$	0.0151	-0.0401	-0.0004	
Computation of Next Trial Value of x				•
Correction Number j	1	2		3
Change in y Between Trials, Δy_j	-0.05	552		
Change in x Between Trials, Δx_j	+1.0			
Slope, $\Delta y_j/\Delta x_j$	-0.05	552		
Mext Change in y Should Equal Minus the Error in y: $\Delta y = -\Delta y_i^0$	+0.04	001		
Next Change in Input x:				
$x = y/(\Delta y_j/\Delta x_j)$	-0.72	262	· 	
Heat Input: $x_{i+1} = x_i + \Delta x$	16.17	38		

M

FILMED)

6-84